WIRED

MAY-JUNE 2023

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TIM MARSHALL
ON CHINA'S OFF-WORLD TAKEOVER

THE EU SATELLITE CEO TAKING ON ELON MUSK

THE NEW SPACE RACE

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Pulling off an epic moonshot

Andrew McCarthy is taking snaps worthy of the James Webb telescope, without ever leaving Earth—all you need is a clear sky, a basic DSLR, and lots of patience

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In an old shoe factory near Paris, a new breed of houseplant is blooming—one genetically engineered to purify your air

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In an extract from his new book, Tim Marshall analyzes China's ambitions for the new Space Race—and what happens if it wins

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A European satellite startup is taking on Elon Musk's Starlink—but first, CEO Eva Berneke must navigate Brexit, war, and sanctions

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A tiny village in Scotland is betting its future on building a spaceport, despite pushback from a powerful landowner

Eva Berneke, CEO of Eutelsat: "When you have two of the biggest business innovators interested in your industry, you should expect a little bit of shaking up."

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Hibernation for humans

Unfortunately for our ambitions to reach Mars, humans are a high-maintenance species. But could astronauts learn how to hibernate?

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Telegram was the app of choice for the anti-establishment, but now its reputation for secrecy is looking less and less secure

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Companies are lining up to mine the sea floor for precious metals—but how much ocean are we willing to sacrifice?

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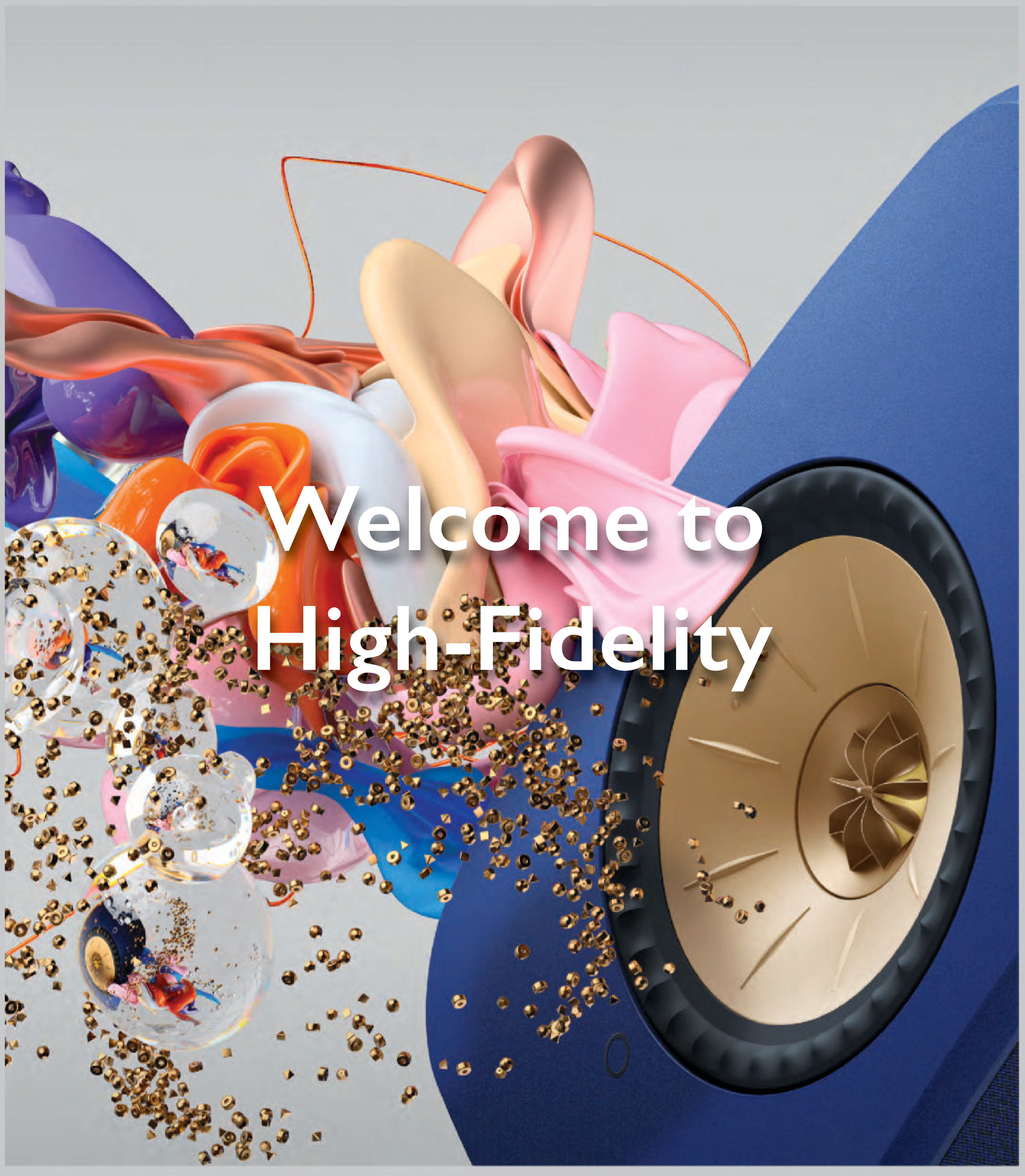

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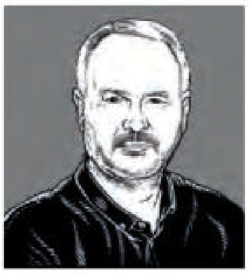
POSITIVE BALANCE

Jack Lawson photographs Gemma McGough—a Patriotic Millionaire who wants the rich to pay more tax: "We used natural light, some flash, and bright backdrops. Gemma was a dream, bringing a positive attitude and lots of patience, even with a four-week-old baby!"

Creating WIRED

STRIKE A POSE

Keanu Reeves and *John Wick* director (and Reeves' *Matrix* stunt double) Chad Stahelski are both 6'1", but positioning one behind the other posed a perceptual challenge for photographer Art Streiber—who ended up having Reeves stand on a quarter apple-box. "The composition was the least complicated of our setups and used just one light source," Streiber says. "It illustrates the pair's cinematic collaboration, which is both brotherly and unique."



TIM MARSHALL

In an extract from his latest *Geography* book, Marshall writes that space is the next geographic frontier, with China poised to dominate: "It's already the only country operating its own space station. In astro-political terms, it's quite a statement."

ANGELA WATERCUTTER

"Keanu Reeves rarely malfunctions," says Watercutter, who interviews the hitman/cyberpunk/surfer dude this issue. "In person, he's pleasant and playful, but he also holds back, calibrating his remarks just so. Is this why we like him so much?"

KATE KNIBBS

Author Margaret Atwood made quite sure our writer knew she was on the WIRED wavelength—"She kicked off the conversation with a very WIRED opening line," says Knibbs. "'Did you know, that amongst other things, I'm also a tech entrepreneur?'"

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PUTTING A PRICE ON NATURE

What is the value of a wild ape? According to a recent talk by the ecologist Ian Redmond at the Rebalance Earth – Natural Capital Conference, to poachers in the Democratic Republic of the Congo, it's about $25. The dead animals are sold for meat, their hands possibly ending up as an ashtray for an oligarch. The creation of value, a tangible dollar significance, lies in the act of killing them. But ecologists argue that there is utility to keystone species like mountain gorillas that is harder to measure: Apes are herbivores—prodigious and efficient seed-dispersal agents. They act to regenerate the forest in multiple ways through their lifecycle, which can be up to forty years, if they're not shot or their habitat destroyed.

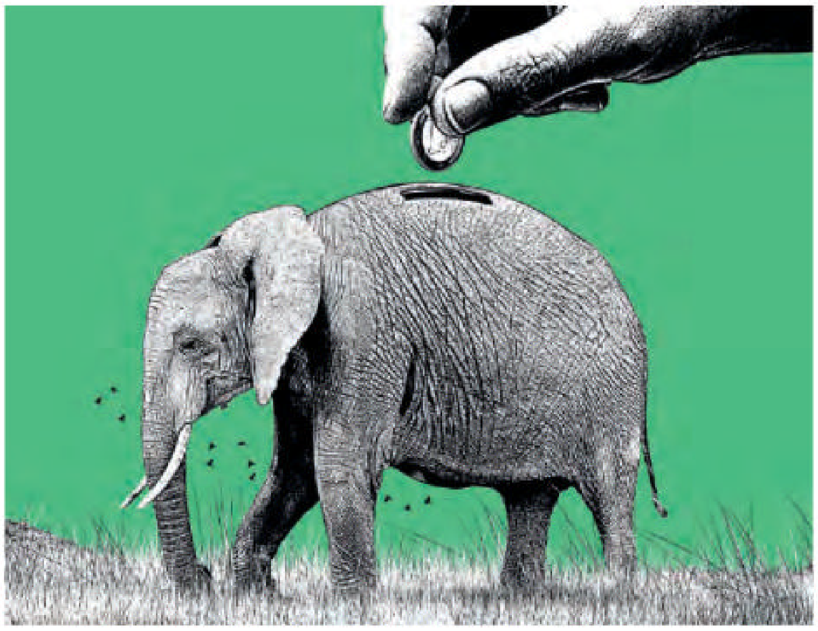
According to the 2022 World Wildlife Fund Living Planet Report on biodiversity, global wildlife populations have plummeted by 69 per cent since 1970. In some areas of Earth, this is closer to 90 per cent. So what are we losing? The answer is that we don't really know. The role of animals in forests and other habitats doesn't appear in current economic models. Boards are not building this into their strategic thinking. According to McKinsey research, although 51 per cent of companies acknowledge biodiversity loss in some way, only 5 per cent have set quantified targets.

The reason is that there are currently no standardized measures for what are euphemistically described as the "ecosystem services" of natural capital. This means that large organizations find themselves in the position where they are investing in sometimes dubious measures such as off-setting in order to hit externally communicated targets. For instance, planting trees. More trees appears to be a good thing, but new forests are often monocultures with extremely limited ecosystems—developing complex systems of flora and fauna takes hundreds, sometimes thousands, of years. They're no substitute for ancient forests that sequester vast amounts of carbon and are intrinsic parts of weather systems through their moisture contribution.

By protecting forests, we protect the broader systemic necessities that enable human activities, such as agriculture. Modeling of weather patterns demonstrates the complex interdependencies: Without, say, the Congo Basin, the farmers of south Asia will not have the rain necessary to raise the staple crops that humans require to survive.

So, how best to bring ecosystem services into the broader economy? Organizations are open to doing this, but need to consider how to implement it without impacting the bottom line. The answer appears to be regulation built upon science-based data that will offer businesses certainty. At the moment, organizations can talk about setting a "nature-positive goal", but there are no clear frameworks in place. Institutional capital pools are slowly beginning to be reallocated away from carbon, but, according to the UNICC, despite climate being a systemic risk to the portfolios of institutional investors, there is still an annual $2 trillion shortfall in the money needed to decarbonize and mitigate the effects of climate change in developing countries. Bill Gates and others use the analogy of a bathtub to describe carbon—we are slowing the flow of water, but the bathtub is still being filled. One solution beloved of institutions—offsetting—doesn't stop the bathtub from filling, but there is broad agreement among scientists that nature-based solutions can both sequester and remove carbon from the atmosphere. It's time to inflate the value of those great apes.

ILLUSTRATION: GREGORI SAAVEDRA



Greg Williams
Deputy global
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Building Responsible Partnerships

Like ordinary plants, this Neo P1 began as a seedling—but one that has been genetically enhanced.

GREEN

START

Edited by
Amit Katwala

TECH

Neoplants' Lionel Mora—aka chief executive gardener—and chief technology officer Patrick Torbey.

At an old shoe factory in the outskirts of Paris, new life is taking shape. Behind a heavy door, a bank of PCR machines multiplies plant DNA molecules by hundreds of billions every few hours. Inside a gleaming white chamber, tiny emerald shoots are coaxed from single cells, unfurling in millimeters over a period of months.

"It's like a biologist's wet dream," says Patrick Torbey, CTO of Neoplants, a Parisian startup taking a multi-million-dollar punt on the air we breathe. Torbey grabs one of the small, plastic receptacles from inside the chamber and squints at his verdant creation: Nestled in a jelly-like growing medium, it looks like a canapé—or, possibly, the future.

This is the Neo P1—a genetically modified houseplant the company claims could help combat indoor air pollution. P1 is a modified form of golden pothos—more commonly known as devil's ivy—one of the world's most ubiquitous and easy-going houseplants. Although its yellow-green hues appear familiar, P1's DNA has been tweaked to enhance its ability to extract volatile organic compounds (VOCs) from the air, including formaldehyde, benzene, toluene, ethylbenzene and xylene, which are prevalent in indoor spaces.

These genetic adjustments also—crucially in the case of the P1—allow the plant to convert the VOCs it absorbs

> "It will be the first time such a product exists. The first computers weren't so great, but they were revolutionary."

into substances like sugar and CO_2 that it can use to carry on growing. Once it's outgrown the agar, P1 will be planted in soil enriched with biochar (a common gardening additive), in a pot designed to maximize airflow, and sold with a pack of three "Power Drops" (bacteria, to be added to the soil each month to help the plant metabolize the VOCs it absorbs). Due on shelves later this year, P1 will retail for $179, or around £145—roughly 10 times the cost of an ordinary golden pothos plant, or in a similar ballpark to a keenly priced Honeywell HEPA purifier.

So far, Torbey, who has PhD in genome editing, and his cofounder Lionel Mora, an ex-Google product marketer, have collected $20 million in venture funding from firms including True Ventures and Collaborative Fund.

Much of the money has gone towards fitting out Neoplants' new space on the north side of the French capital. Over the past two years it's been stripped and gutted, whitewashed, and then refitted to spec with every gadget Torbey could tick off his wishlist. There are mass spectrometers, fume cupboards, and growth chambers. Magnetic stirrers fidget next to cabinets stocked with glass flasks and petri dishes.

There are two rooms whose insides are coated in a greenish, non-adsorbent material (meaning that organic compounds won't stick to it). In the months to come, they'll be used to mimic bedrooms, for a more accurate measurement of how well Neo P1 strips toxins from the air.

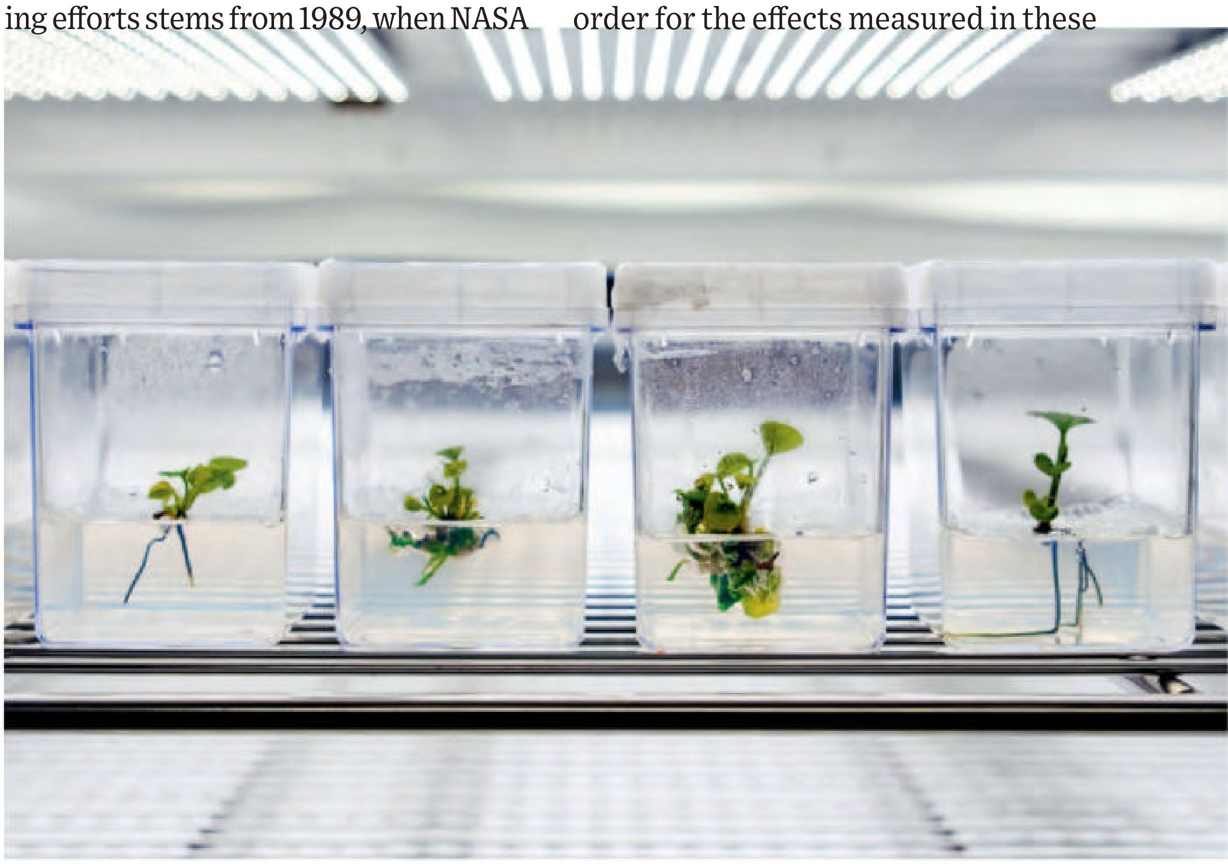
Neoplants' proposition is an attractive one: Neatly pairing something that looks nice in people's homes and brings them joy (houseplants), with one of the biggest existential challenges facing humanity at large (slowly choking to death from pollutants). But proving that it actually works is where things get thorny.

Browse most plant shops and you'll be met with the promise of purified air: Peace lilies and snake plants and ivy with little tags—pale blue or white, or some other color suggestive of purity—declaring that "this plant cleans air". Patch, a popular online retailer, reserves an entire section of its website for "Air Purifying Indoor Plants". Another vendor, Plantler, offers an "Air so Pure" package of spider plants, palms, and ferns.

Much of the support for these marketing efforts stems from 1989, when NASA worked with the Associated Landscape Contractors of America to assess the ability of houseplants to remove toxins from the air. The resulting Clean Air Study suggested that, yes, houseplants could absorb certain pollutants—including VOCs such as benzene, formaldehyde, and trichloroethylene.

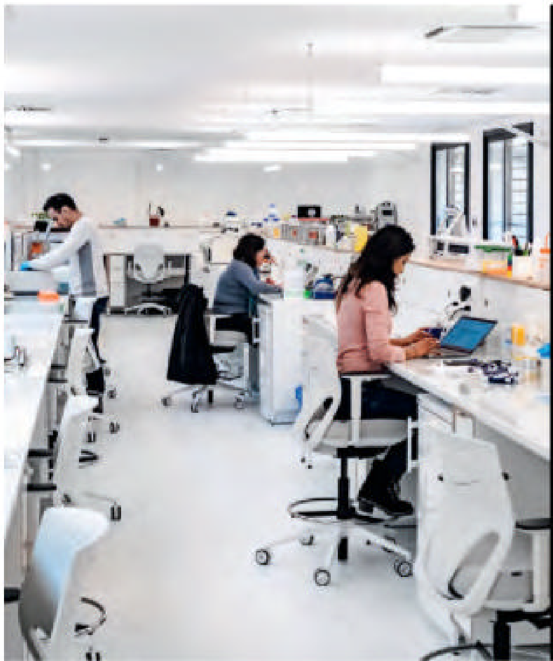
Less touted was the fact that these results mostly could not be applied to the houses these plants are often placed in. Putting a plant in a sealed chamber, blowing pollutants over it for multiple hours (or days), and then recording the results, the researchers admitted, was not an accurate replication of normal houseplant conditions. This has not stopped many researchers since conducting almost exactly the same experiment.

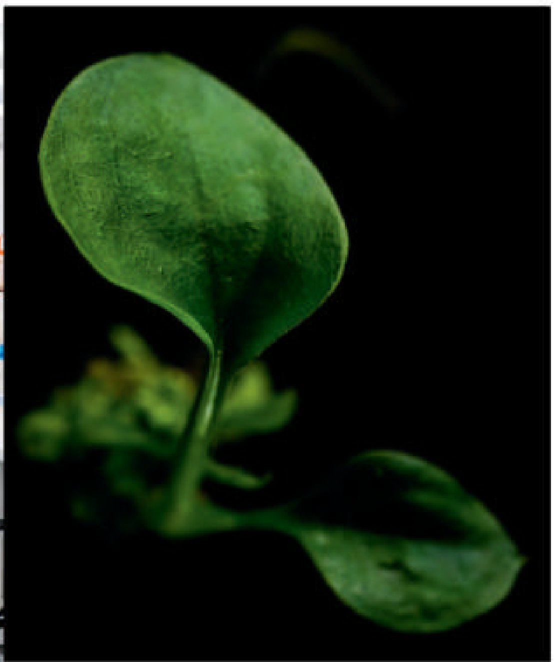
In 2019, however, researchers at Drexel University concluded that, in order for the effects measured in these



Neoplants' Neo P1 seedlings are nurtured in a jelly-like medium in controlled conditions.

PHOTOGRAPHY: JULIEN FAURE





Neo P1 isn't yet on sale, but researchers are already working on its successor, the P2.

Neoplants claims it has a waiting list of 30,000+ people for its modified golden pothos.

chamber experiments to be reproduced at any liveable scale, and to even match the rate of toxin removal already achieved by just opening a window, you'd need anywhere between ten and a thousand plants per square meter.

Richard Corsi, Dean of the College of Engineering at UC Davis, also takes umbrage with what he calls these "little glass chamber studies." The issue, he says, is that to get their results, researchers exaggerate the amount of air that would ever flow over a plant in normal conditions. The industry's standard metric for the effectiveness of air filters is clean air delivery rate, or CADR. It combines separate measures for airflow and how efficiently particles are removed. The idea is that by combining these measurements into a single metric, consumers are less likely to be misled by, for instance, an air filter that is incredibly efficient at removing toxins, but only for a small amount of air.

The goal is for Neoplants' Neo P1 specimens to be used to filter air in homes, hotels, and offices.

Using data from past plant studies, and calculating based on the best case scenario in terms of clean air delivery rate, Corsi says that a bedroom of approximately 200 square feet would need as many as 315 individual plants to bring formaldehyde (and other VOC) levels down by 50 per cent. To get a 90 per cent reduction would require more like 2,800 plants. Scale that up to a whole flat, or house, and you're nurturing a dense jungle. So is Neoplants' genetically modified house plant any better? The company's sales materials reference the 1989 study, and claim the P1 is "30 times better than top NASA plants" when it comes to removing VOCs. But this was a lab-based study: Neoplants pumped formaldehyde, benzene, toluene, and xylene over a P1 sample contained inside a 35 liter glass chamber, and then compared the outputs. Field tests are yet to yield reliable results, but the hope is that the new lab, with its specially designed non-adsorbent rooms, will allow more true-to-life testing in future.

This seedling contains modified DNA, which enables it to process volatile organic compounds.

There's no CADR measurement to compare the P1 with mechanical air purifiers either. Instead, Neoplants offers a "CADR by weight" to reflect the varying sizes of different plants. Even if the P1 is 30 times better than a traditional houseplant, you would still need a lot of them to clean the dirtiest air.

A new metric might be required for this product category, Mora argues, because plants—unlike traditional air purifiers—don't get switched on and off (although they do have extended dormant periods in most years). Neoplants has hired two people to devise a measurement that better suits its purposes.

Right now, P1 amounts to trays of tiny shoots stored in growth chambers. It takes six months to take each plant from a single cell to a shoot of a few inches in height. More than 30,000 people have so far signed up to a waiting list via the Neoplants website; interested parties include hoteliers and real estate developers. Mora is cutting deals with growers in Florida who'll be able to reproduce their plants at scale (the US, where the regulatory process for clearing genetically modified products is more straightforward, will be Neoplants' launch market).

The lab move-in isn't quite complete—a workman's brush props open the front door, fresh tarmac is being flattened into potholes in the courtyard—but the new facilities will enable Mora and Torpey to run more rigorous, realistic tests. P2 is already in the works, and the business is further exploring how its gene-editing technology could be deployed in carbon capture or phytoremediation (through which plants are used to absorb toxins from contaminated environments).

The company is banking on a bit of patience, a dose of belief—green shoots need time to grow. "It will be the first time in history that such a product exists," says Mora. "The first computers, they weren't so great. But they were revolutionary."

WILL PRITCHARD *(@wf_pritchard) is a writer, editor, and producer in London.*

PHOTOGRAPHY: JULIEN FAURE

ILLUSTRATION: ANTONIO SORTINO

Putting people at the heart of change

We're in a time of economic upheaval, but it's important to keep humans at the core of any transformation, to ensure the best outcomes for everyone

As businesses navigate through challenging times, many seek to proactively change their fortunes, rather than becoming hostage to macro-economic trends. Eighty-five per cent of senior leaders have been involved in two or more major transformations in the last five years, according to data from EY. But navigating organizational change in challenging economic times can be tough, and involves difficult decisions.

One way to overhaul a business positively is by listening to people. It's a cornerstone of how EY teams work in helping transform businesses.

"We help organizations build cultures which center transformation around the people impact," says Benoit Laclau, consulting managing partner for the United Kingdom and Ireland at EY. The most successful companies—ones that generate exponential value—put people, whether customers or employees, at the heart of their organizations. In fact, organizations which put humans at the center of transformation are 2.6 times more likely to succeed.

EY is often called upon to help enact that mindset shift, reframing how a company works, and rebuilding in a more customer- and employee-centric way. "For decades, we've been focusing on putting people at the center of decisions, as they're the ones who are most affected by any changes," says Laclau.

One example of the consultancy being brought in to refigure how an organization works is at Maidstone Borough Council. They were attempting to address homelessness in the area, which had risen by 58 per cent in a little over five years. It was an issue exacerbated by disconnected data that failed to provide the insight and crisis indicators council staff needed in order to take proactive approaches. The challenge set was to understand if data could stop homelessness before it starts.

EY teams and technology partner Xantura collaborated to develop a data-centric, people-focused tool called OneView that combined predictive analytics and natural language generation capabilities. The tool could identify residents at risk of homelessness, and so help the council devote resources to intervene and help people before they fell into homelessness. Within the pilot year of the scheme, nearly 100 households were saved from being left without a home. Since then, OneView has helped reduce homelessness across Maidstone by 40 per cent.

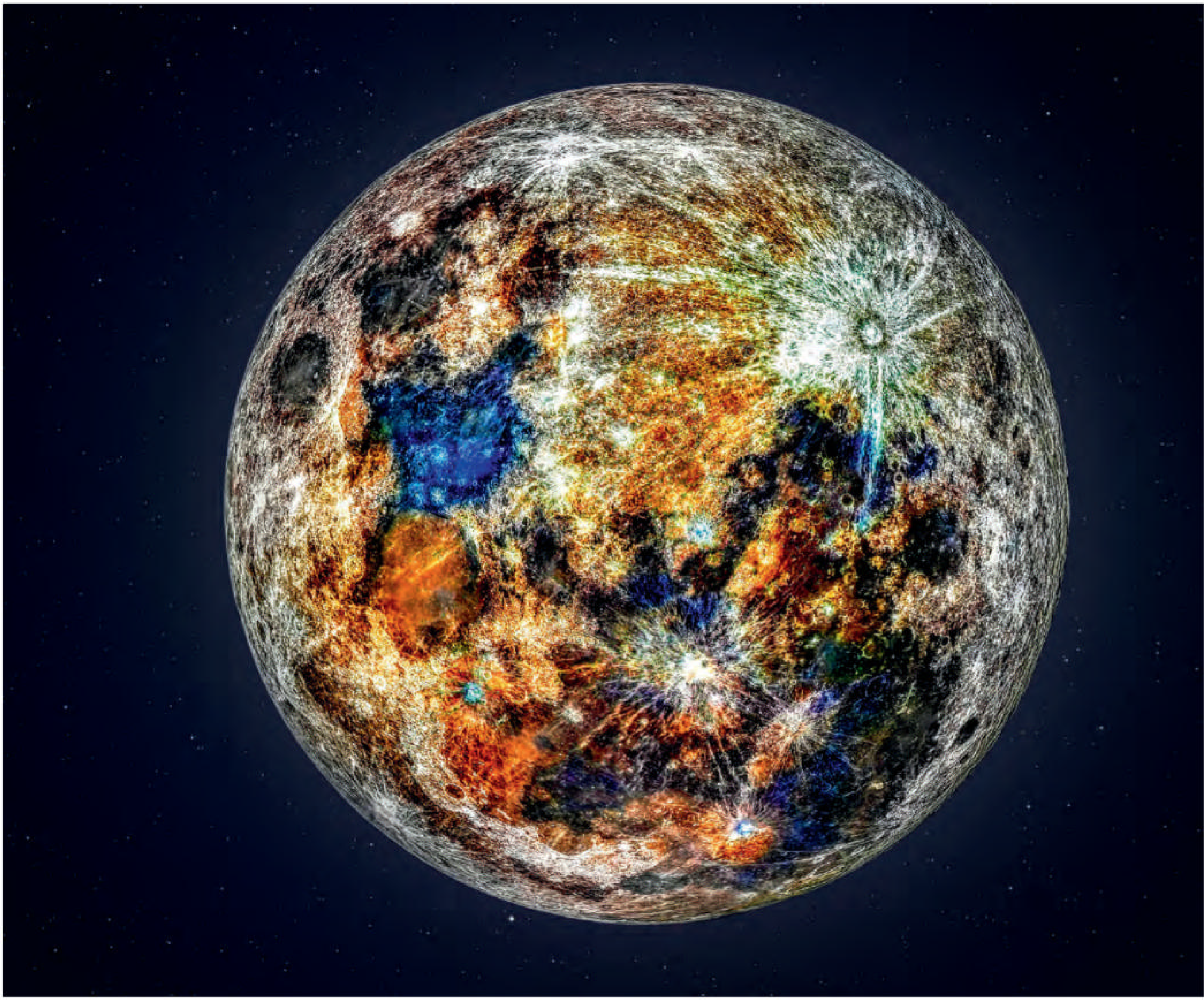
The OneView program succeeded because it put people at the center of the process, working collaboratively with all stakeholders, asking the right questions, and reaching better answers. "People are central to the better running of an organization, and so putting them at the core of any transformation increases its likelihood of success," says Laclau.

The project has had a truly transformative effect on Maidstone, as the borough faced a major homelessness problem. And the results also had a halo impact beyond the immediate issue—the program generated £2.5 million in broader societal savings, reduced time taken on administrative tasks by 61 days, and consolidated 15 different data files together, allowing easier access to important information for Maidstone Borough Council employees.

While complex transformations are daunting, particularly at moments of economic downturn, success is possible with people by your side. Could your organization follow in Maidstone's footsteps? What's stopping you from realizing your transformation?

Understanding how change affects all stakeholders leads to greater success.

Sorry, astronomers, but with a little patience, a basic DSLR, and some photo-editing wizardry, images worthy of the James Webb Telescope can be taken from here on Earth. Photographer Andrew McCarthy shares his pro tips for creating interstellar art, no rockets required



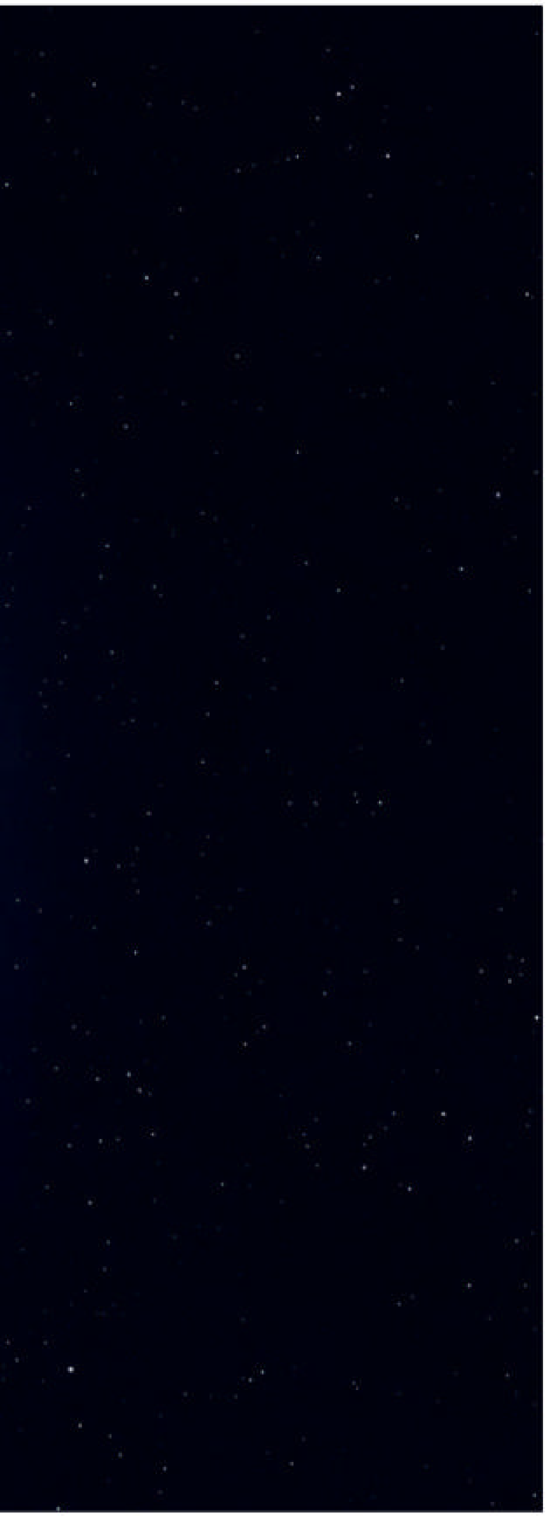
PULLING OFF AN EPIC MOONSHOT

As the sun sets, Andrew McCarthy scans the skies for bad omens: Twinkling stars and wispy contrails. But he's not an oracle or mystic. In fact, McCarthy is an astro-photographer, and these subtle clues are indicators of a hazy atmosphere that could foil his attempts to take pin-sharp pictures of the cosmos.

From his back garden in Florence, Arizona, McCarthy creates beautiful images of distant stars and celestial bodies. He is perhaps best known for his shots of the moon, which capture the intricate details of every crevice and crater. But deep space is his favorite subject—his Instagram feed, which has garnered more than half a million followers, seems to crackle with the deep purples and royal blues of nebulae and supernovae.

Mineral Moon was made from 150,000 shots. The added colors indicate mineral deposits.

This image of the North American Nebula in the Signus region took 15 hours to capture.



Taking such detailed photos requires a combination of skill, knowledge and patience. First, McCarthy must wait for a sky clear of atmospheric haze. "I've spent entire days doing it and not getting a single photo," he says. Then, he fires off a series of shots in quick succession, which he later stitches into a mosaic to make the final image.

McCarthy's interest in space started as a kid. His father was an amateur astronomer, and McCarthy remembers being called out into the garden to peer through his dad's telescope when around eight years old. "I'd look in, and there would be Saturn, right there in my field of view, floating out there in space," he says. "I look back on those memories fondly."

That experience, combined with a love of *Star Wars* and *Star Trek*, prompted him to buy his own telescope in time for the "Great American Eclipse" of August 2017—a total solar eclipse visible across the US from Oregon through to the South Carolina coast. He became obsessed.

Soon, McCarthy was staying up night after night developing his craft. He wanted to share his obsession with other people, and started uploading a new photo to his Instagram feed every day. New followers began to trickle in.

Everything changed when, a few years in, McCarthy used a special "high dynamic range" method to photograph the waxing crescent moon, bringing both its dark and light sides into view in a sky glittering with stars. The number of people following his Instagram account rocketed from a few hundred to tens of thousands.

Then, at the beginning of the pandemic, McCarthy was laid off from his job in business operations for a tech company in California. He decided to turn his hobby into a full-time job. "I was really just looking for a way to pay the bills, and was already kind of well known by that point (about 150k Instagram followers)," he says. "So I thought, 'What the heck, I'll just see if I can sell prints to people and get by'."

McCarthy spends a lot of his time outside beneath the stars. But some of his most important work happens inside, at his desk, where he "processes" each image. Processing is different to editing, which is a common misconception, he says. The software in most digital cameras processes images automatically. But to shoot high-resolution space photos, McCarthy has to do it himself. This involves combining the color-filtered images, which he must shoot separately, reducing the "noise", and balancing the colors. It can take anything from a few hours for an image of a planet, to weeks for large-scale photographs of the moon or sun.

McCarthy plans to continue taking photographs of space, so long as he can support himself from his print sales and Patreon subscriptions. His motivation to help others experience the wonder of space abides. "I think it'll really do something positive in the world if people are able to spend more time looking upwards," he says. *cosmicbackground.io*

CHARLIE METCALFE *(@cafmetcalfe) is a writer in the UK and Germany.*

Shooting for the stars? Get the basics down before going galactic

You don't need a big, fancy telescope:

McCarthy says that basic DSLR kits can capture galaxies and nebulae, just by pointing at the night sky—and no telescope needed.

Work with a mentor:

Beginners should join groups online and find mentors in the astro-photography community who can advise on technique, and on the best kit for their budgets.

Learn the positions of important skymarks:

A pair of binoculars will help you learn the positions of planets and brighter nebulae and galaxies—it's best done away from light pollution.

PHOTOGRAPHY: ANDREW MCCARTHY

Are you a designer developing apps, games, websites or online services?

You are now required to design with children in mind.

If you are creating online products and services, it's important you know the age of your users. If your work is likely to be accessed by children, you need to use the Children's code.

Check ico.org.uk/cc-designguidance or call our helpline on 0303 123 1113.

ico.
Information Commissioner's Office
children's
code

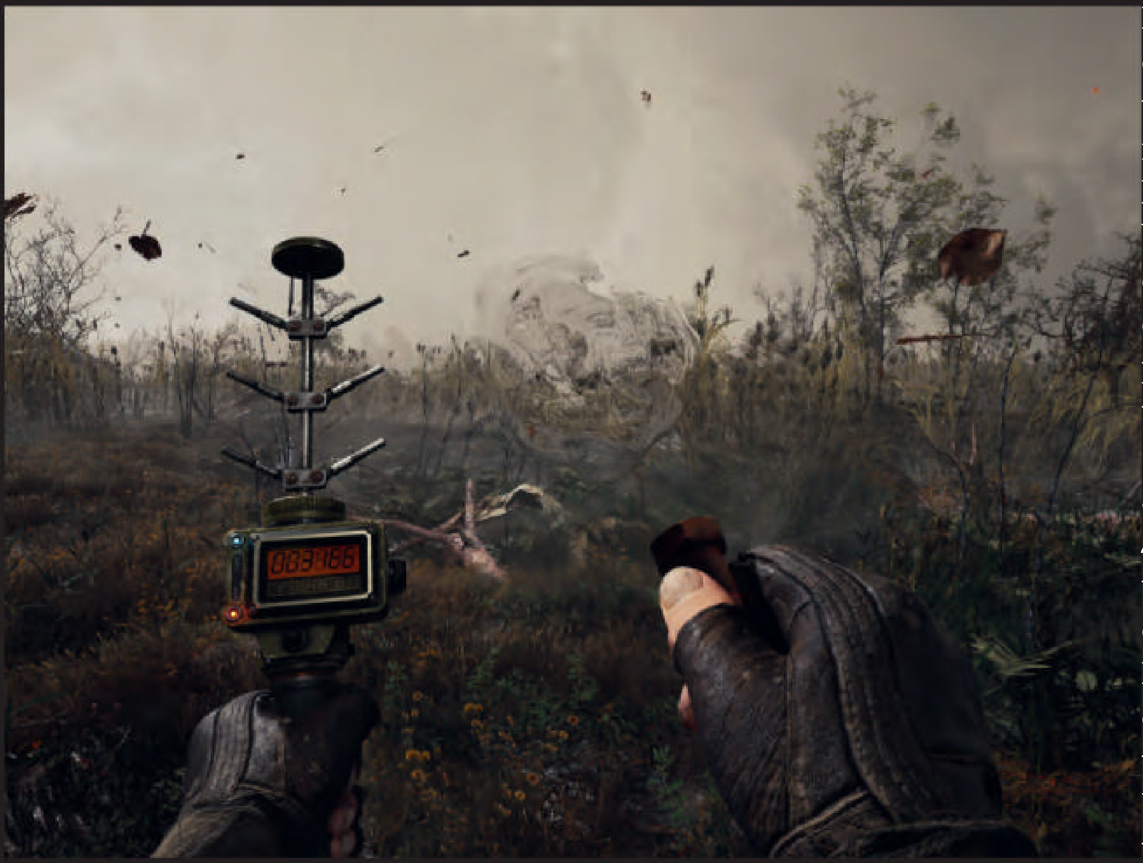
DEVELOPING RESILIENCE UNDER FIRE

The S.T.A.L.K.E.R. 2 team had to navigate the war in Ukraine while building the sequel to their hit shooter. Now the result is more than a just game—it's about national identity

The offices of GSC Game World smelled like a gas station. The Kyiv studio, responsible for cult-classic *S.T.A.L.K.E.R. Shadow of Chernobyl*, had stockpiled thousands of liters of fuel in its corridors during the nervy winter of 2022. Who could blame them?

Headlines earlier that year had warned of an imminent Russian invasion. GSC Game World is known for taut gunplay, but now the studio was forced to contend with a more pressing reality. "Emergency buses were waiting at the GSC office throughout the winter, with drivers ready for action," says Maria Grygorovych, lead producer on sequel *S.T.A.L.K.E.R. 2*.

GSC is one of the many Ukrainian companies attempting to stay afloat despite the mass displacement, comprehensive shortages, and frequent trips to public shelters that define an active war zone.



↑ *S.T.A.L.K.E.R. 2* runs on the Unreal Engine 5, and combines horror, sci-fi and shooter genres.

As reports from the Russian border grew more dire and foreign countries started recalling their embassy staff from Kyiv, GSC offered to move some of its employees to Uzhhorod—a town close to Slovakia and Hungary. Two hundred workers and their families agreed to participate, while others spilled over into nearby Budapest. Those who made the trip to Uzhhorod packed one suitcase each and hauled whatever tech they could harvest from the office.

Today, GSC Game World is a two-pronged company: 130 employees are still in Ukraine—some on the front lines— and 200 have relocated to Prague after an elliptical refugee trek through Eastern Europe.

In total, Grygorovych and the rest of GSC's leadership needed to evacuate 500 people, including the company's employees and family members. "The inner relocation was pure chaos," she says. "Renting a car was an almost impossible task, and the railway and bus stations were flooded with people. We needed to be extremely concentrated every second. The emotional overflow came much later, when the majority of the evacuation process was completed. But the danger was real."

The GSC employees who are still in Ukraine work from their homes. Zoom calls are interrupted by air-raid sirens, and if someone is AFK for too long, Grygorovych can't help but fear the worst. Lately, Russia has increased its assault on Kyiv's power grid and heating installations, so GSC coders attempt to squeeze as much work as they can into the scant few hours when the internet is relatively stable. "We have dreams of returning to our office in Kyiv," said Grygorovych. "Everyone wants to return home. But some people actually don't have a place to return to. Each Ukrainian has lost something."

As of October, GSC's Prague HQ is operating at full capacity. When *S.T.A.L.K.E.R. 2* arrives, it will be among the first full-throated statements of Ukrainian artistic expression to launch since the invasion. Previously, the game's subtitle read 'Heart of Chernobyl'. The team has since altered this to 'Heart of Chornobyl' to reflect the Ukrainian, rather than Russian, spelling of the region. All eyes are on Ukraine, which means all eyes are on *S.T.A.L.K.E.R. 2*. After all they've been through, the GSC Game World team smells victory.

"It was a game about Chornobyl, which is actually located in the Kyiv region, made by a Ukrainian team before the war, and it became something incomparably bigger after the invasion," says Grygorovych. "It's a national product now, aimed to show that Ukraine is not only exceptionally effective and brave on the battlefield, but equally valuable in a sense of cultural legacy. Something to be shown to the world."

LUKE WINKIE *(@luke_winkie) is a writer and former pizza maker from San Diego.*

WORKING WITH THE 1 PER CENT

A group of multi-millionaires has an old idea for new money: tax their wealth to solve the cost of living crisis for everyone else

In the summer of 2017, Gemma McGough found herself to be a member of the UK's 1 per cent: a multi-millionaire from the sale of her company Product Compliance Specialists. She'd never have to work again.

Then she read *This Changes Everything*, Naomi Klein's book about the impact of capitalism on the climate. "It was a massive shift in my thinking," she says. "I sold my Porsche and bought a Tesla."

In 2019, she founded Eleos Compliance, modeled on the B Corp principles of transparency and social and environmental accountability. She took a salary, but her income was mainly from investments, bonds and rental properties—from wealth.

McGough analyzed the tax she was paying on her salaried income versus the lower rates on income from the sale of assets. She concluded first that the country's tax policy was unfair, and second, that she could be contributing more. Yes, she had worked long hours over 20 years to build her first business, but lots of people worked hard, only to be left with "a mortgage and many more hours to work".

Philanthropy wasn't enough. McGough and her husband have given away approximately £400,000 in the past three years, mostly to reforestation, rainforest conservation, and strategic land purchases. "It's a lovely thing to do, it's a pleasure," she says. "But ultimately it's not the answer when you need a system level change." So in 2021, McGough became one of four British "wealth-holders" to join the UK branch of Patriotic Millionaires, a group of multi-millionaires and billionaires who want governments to tax them more.

The organization was set up in the US in 2010 and has 240 members there; McGough is a founder member of the UK arm, which has 20 members. They attend monthly meetings, coordinate media activity, and advocate for taxes on net wealth at parliamentary events.

The larger intention is to bring together connections, financial and tax expertise, status, access, and a few famous names, such as the entertainment scion Abigail Disney. Actor Mark Ruffalo is a signatory on the recent "Cost of Extreme Wealth" open letter delivered to the World Economic Forum's Annual Meeting this January.

Why speak up when you've won the game? McGough admits that her "hard up" working class background might make her more likely to feel that she now has "enough". She left school to begin work at 16, and set up her first company with her ex-husband with "two laptops and a list of contacts". Luck and timing played a role—her RF compliance company ended up being part of a growth industry.

The Patriotic Millionaires are keen to stress the economic case that wealth taxes could increase stability and help to sustain both a healthy, educated workforce and a middle class of consumers with disposable income—so paying more tax could end up being good for wealthy business people. For McGough, though, it's about fairness and common sense in an era of inequality and deteriorating public services. The richest 1 per cent of Brits hold more wealth than the poorest 70 per cent combined. "I see it as a problem if you've got so much money that you no longer need a functioning society," she says.

The million dollar question, then, is how much tax? In the UK the group is calling for an annual wealth tax of 1-2 per cent for wealth above £10m, which would affect around 20,000 people, but could generate up to £22 billion a year, according to analysis from the Wealth Tax Commission at the LSE and the University of Warwick. That's almost enough to give the entire

PHOTOGRAPHY: JACK LAWSON

public sector a pay rise in line with inflation. Only four European countries—Spain, Norway, Switzerland and Belgium—collect net wealth taxes, with levies in France and Italy on selected assets.

The cases against a wealth tax range from "I pay enough already", which McGough says she has encountered a lot, to arguments around administrative costs, the risk of capital flight and the potential increase in tax avoidance and evasion. It was a mix of bureaucratic issues and fears of a crisis of confidence in the markets which prevented Harold Wilson's government from introducing a UK wealth tax in the 1970s.

As for capital flight, it's conceded that some wealthy individuals may leave or move their money as a result of tax rises. But analysis by Cristobal Young, an assistant professor of sociology at Stanford University, suggests that the majority would remain: While 5 per cent of billionaires live a transnationalist lifestyle between London, Switzerland and tropical tax havens, the remaining 95 per cent live in their country of birth, education, or where they started their business.

A new class of conscious multi-millionaires—the UK arm is yet to snag its first billionaire—is leveraging its access to advocate for new wealth taxes to all-party parliamentary groups, partnering with Tax Justice UK. Long-term, though, the group is opposed to this kind of influence of wealth on politics via private lobbying and its undermining of trust in democracy. But for now, the invitations to Westminster are viewed as a necessary evil.

Perhaps they're also a signal that the self interest extends beyond the business case. As some billionaires build luxury bunkers, US members such as investors Nick Hanauer and Karen Stewart are preoccupied with pitchforks and the fates of Marie Antoinette and the Romanovs.

The Patriotic Millionaires' plea to tax the rich could cut through precisely because it is coming from the wealthy themselves. Researchers from King's College London and the University of St. Gallen, Switzerland surveyed the history of wealth taxes in 2021, with data from 1880 onwards across 45 countries. They found that the forces of democratization and modernization and even the outbreak of wars do not usually speed up the introduction of wealth taxes. Instead, they have mainly been used as an emergency tax when countries faced the shock of an economic recession. As with McGough's own success in business, the timing might be everything. *patrioticmillionaires.uk*

↑ Gemma McGough believes the rich have a responsibility to pay more taxes, to ensure that the society that enabled their success can thrive.

SOPHIE CHARARA *(@sophiecharara) is an associate editor at* WIRED.

Forget the flat white—the world's two favorite caffeinated species are in danger of flatlining, thanks to environmental pressures from our changing climate. Could a spurned 19th-century alternative solve the brew's existential crisis?

BRINGING BACK COFFEE'S HAS-BEAN

Fine. You're a single-origin coffee snob. But how far into the depths of coffee connoisseurship have you *really* dived? There are 124 coffee species, yet just two—arabica and robusta—account for some 99 per cent of global coffee production. This narrow reliance is starting to look foolhardy, with plantations coming under pressure from diseases, drought, and poor growing conditions.

Enter liberica. It's the hipster bean that some coffee aficionados hope will herald a more resilient—and delicious—future. "It's surprising a lot of people," says Aaron Davis, a coffee specialist at Kew Gardens in London, and author of a new paper in the journal *Nature* arguing that liberica's time has come. Coffee importers and sellers are starting to pay attention to liberica, he says, thanks to its distinctive taste and ability to handle conditions other species can't. So why isn't it more popular?

For a brief period in the late 19th century, liberica was the bean *du jour*, thanks to its resistance to leaf rust and that it grew well in warmer lowland regions, unlike fussy arabica, which prefers cool temperatures and higher altitudes. For a while, liberica and arabica were the two big beans in the global coffee industry.

Alas, liberica's time at the top of the (coffee) tree did not last. Its big fruits were harder for coffee manufacturers to process, and the knobbly beans inside were prone to being either over- or under-dried, resulting in a subpar brew. When coffee production in Brazil started to boom around the turn of the 20th century, most plantations opted to grow expensive, smooth-tasting arabica, which quickly became the top dog in the international trade. In second place came robusta, which is cheaper and packs a higher caffeine punch. You'll usually find it in instant coffees or blended with arabica.

One of liberica's big disadvantages against these titans is that, unless it is processed and roasted carefully, its taste can be off-putting. "I first tasted liberica back in 2012 and wrote it off as being completely disgusting," says Davis, who describes something akin to tinned soup. People who taste coffee for a living have a name for this: vegetal. It's a polite way of saying that the coffee *sucks*.

But in the right hands, liberica can be a revelation. In 2016, Davis visited some coffee farmers in Uganda and tried a brew of their local beans: It was sweet, smooth, and had notes of jackfruit. He started bringing beans back to the UK and sharing them with coffee importers. They were impressed too, and saw the potential for a high-yielding, tasty bean that could grow across a relatively wide range of locations. "We are talking about people who are doing this for profit, not for passion. If it's not commercial then they're not going to be interested," Davis says while sipping on a coffee made with a variety of liberica beans, called excelsa.

In south London, Nigel Motley is one of the very few UK-based coffee shop owners also extolling the virtues of the liberica bean. Liberica coffee is widely grown in the Philippines, where Motley's mother is from, and there it is called barako, which loosely translates as "stud", and has strong associations with masculinity. "It's seen as this horrendously strong coffee that would give you fuel for the day," says Motley.

Davis is particularly excited about the excelsa variety of liberica. This has smaller, more manageable fruits that are easier to process than the usual chunky liberica beans. A coffee bean is actually the seed of a small cherry-like fruit that grows on coffee plants. The less pulp there is surrounding that seed, the easier it is to harvest and process those fruits. Liberica plants—including excelsa—are also more resilient to warming temperatures. "We're seeing excelsa and liberica as something you can grow when you simply can't grow arabica," says Davis.

Having more coffee species to choose from isn't just nice to have—it might be vital to preserve the livelihoods of people who grow coffee for a living. For example, coffee makes up a quarter of Ethiopia's total exports, and between 39 to 59 per cent of its current growing area could become unsuitable for coffee farming as the climate warms. As other coffee-growing regions get hotter, the need for a plant that's more resilient to higher temperatures will become even more pressing.

"You've got to be able to produce coffee under a changing climate," says Davis. And if the history of coffee teaches us anything, it's that things only really change when the alternative is no coffee at all.

MATT REYNOLDS *(@mattsreynolds1) is a senior writer based in London.*

ILLUSTRATION: RIVER COUSIN

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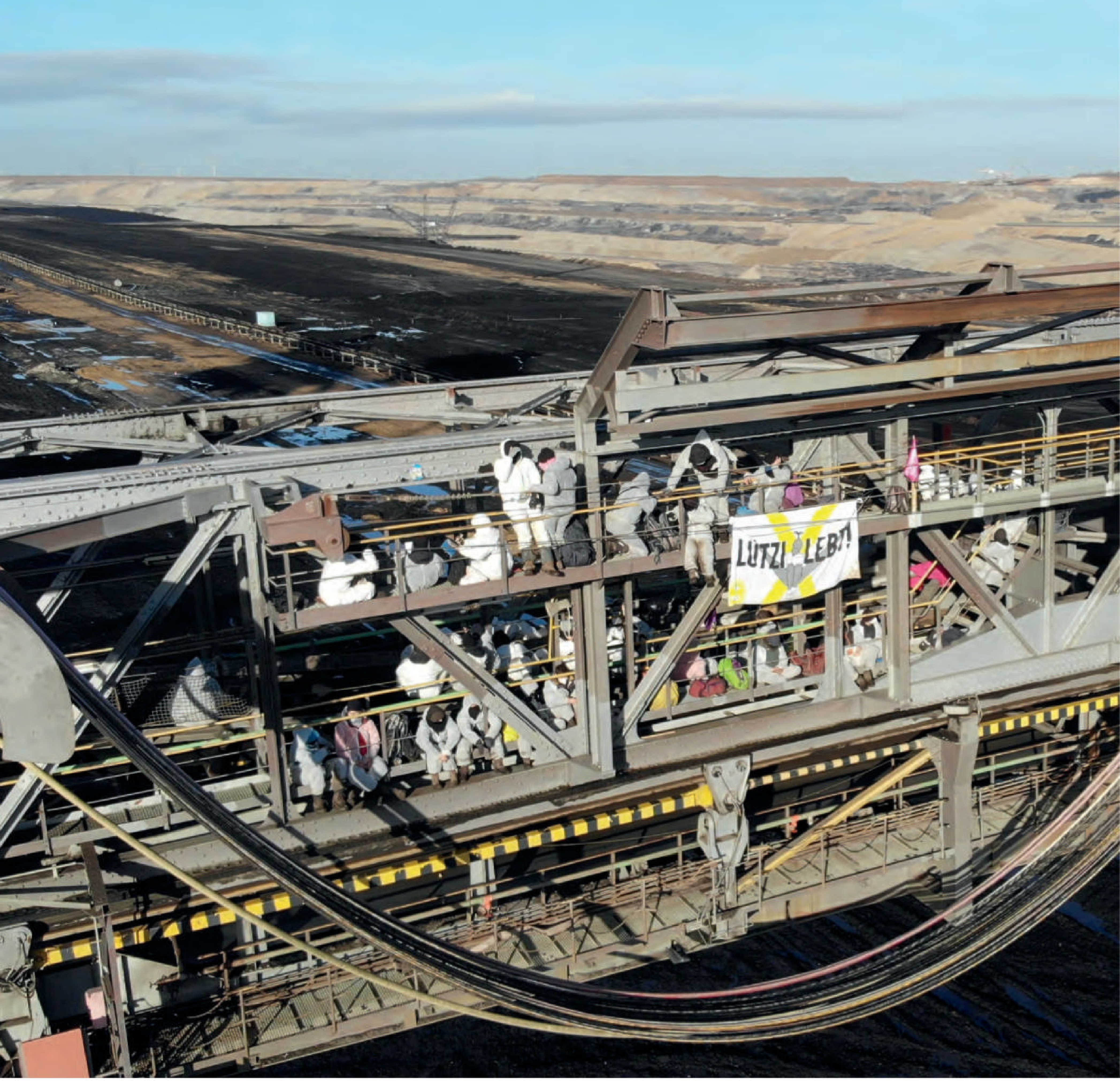
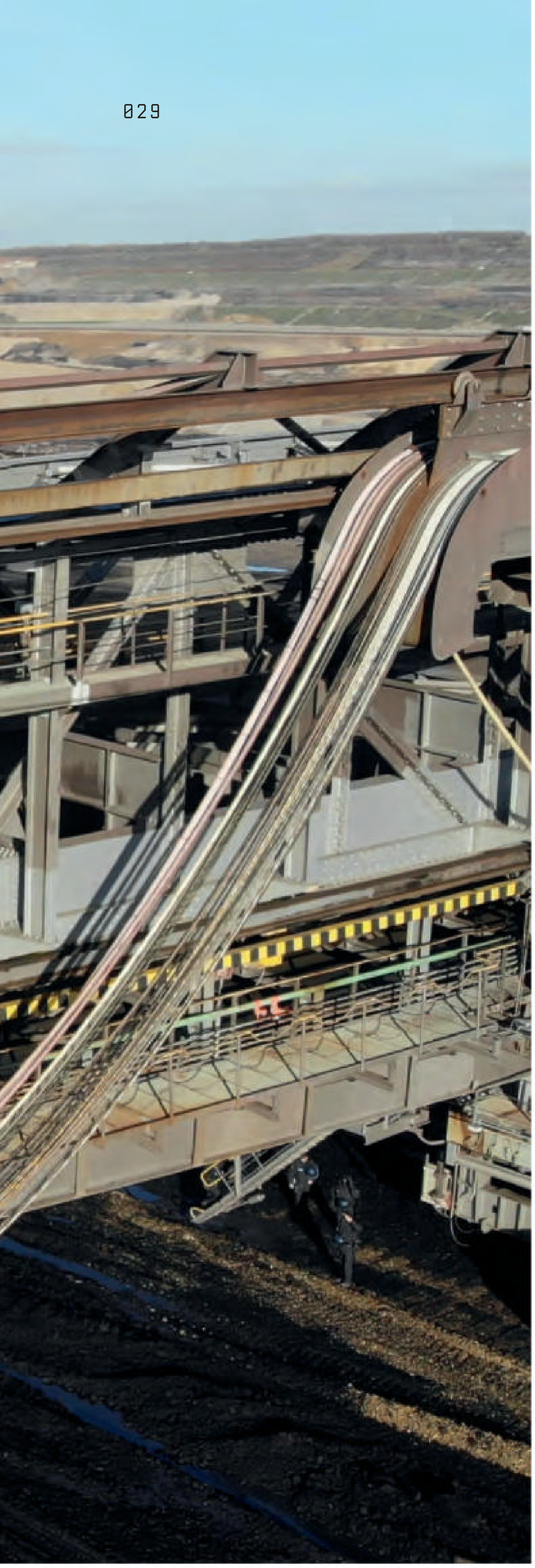


THIS COAL MINE IS PRESENTED BY THE GREEN PARTY

Formerly eco-friendly governments are resorting to fossil fuels such as lignite to bridge their energy crisis shortfall—but protesters are pushing back

In January, the German hamlet of Lützerath fell prey to a ravenous beast. A giant bucket wheel excavator (BWE) clawed at the ground, gouging free great chunks of earth as a line of riot police held back horrified protesters. For weeks, environmental groups had tried to stop the abandoned village of Lützerath from being bulldozed to make way for a new coal mine: They marched, they glued themselves to fences, two activists known as Pinky and Brain even spent days hiding in a self-built underground tunnel system. Eventually, though, the police dragged all of them out of the mud



Activists occupy the receiving conveyor of a BWE. "Lutzi Lebt" means "Lützerath Lives".

> "What we are pointing out with Last Generation's protests is that our government is not capable of dealing with this crisis."

German police came prepared to remove environmental protesters from Lützerath.

to make way for the machines of RWE, Germany's biggest power company.

It's not unusual for environmental activists to clash with the police. It's not particularly unusual for RWE to build a lignite mine—it has three in Germany already. What made this case stand out was the fact the mine had been approved by Germany's Green Party.

When the Green Party entered coalition government in 2021, it was hailed as a landmark moment for the environment—supporters hoped the party would follow through on its promises to take a hard line on fossil fuels. But since Lützerath, climate activists have turned against the Greens—seeing the mine as emblematic of the compromises Green politicians have been willing to make to climb the political ladder.

As protesters faced off with police in front of RWE diggers, Green Party premises around the country were vandalized. In Leipzig and Aachen, Green Party office windows were smashed. In Flensburg, activists forced their way into the constituency office of Green politician Robert Habeck, refusing to leave. In Dusseldorf, 250 kilos of lignite—the type of coal RWE plans to extract from Lützerath—was dumped in the street in front of the regional Green Party headquarters. A protester brought a wooden cross to symbolically bury green ideals. Luisa Neubauer, head of campaign group Fridays for Future's German chapter, described the government as missing "ecological backbone". The link between the Green Party and the environmental movement that birthed it was officially severed.

The backlash to the Lützerath mine crystallizes the balance that Green parties across the world must find as they take power; finding an equilibrium between idealism and pragmatism; their environmentalist base and the wider electorate.

"The environmental movement was very close to the Greens before they entered government," says David Dresen, an activist with the group All Villages Must Stay, which campaigned to save the villages near the mine. But after Lützerath, that relationship is now broken, he says. Dresen, who lives 600 meters from the mine, voted for The Greens in 2021. But he says he would not vote Green again—at least while the party's current leaders are in charge. "Even a lot of NGOs that are not that radical are now saying they can't trust them."

The Lützerath coal mine deal was personally announced by Habeck, one of the most successful green party politicians of his generation, who now sits in the top levels of German government as deputy chancellor. Habeck might be the subject of distrust among activists, but within the country at large, he's popular. He's helped the Greens appeal to a broader electorate than its environmental base, says Peter Matuschek, CEO of German pollster Forsa. This is a shift for a party that has its roots in Germany's anti-nuclear protests of the 1980s. "But this more pragmatic style the party has adopted in the last two or three years has helped them strengthen their position," Matuschek adds.

That pragmatism has been on full display during Europe's energy crisis, as Habeck has been forced to embrace uncomfortable compromises. When Russia slashed gas supplies flowing into Germany, Habeck ordered the country's coal stations back into service. When utility company RWE requested to extract coal

PHOTOGRAPHY: ARTIST AND ACTIVIST JOANIE LEMERCIER

→ Bucket wheel excavators are commonly used to strip-mine lignite, or “brown coal”.

↓ The Garzweiler mine covers 19 square miles. Its expansion will eradicate nearby Lützerath.

from underneath the western German village of Lützerath, arguing this was necessary to keep Germany’s lights on, Habeck agreed. In return, RWE would have to end coal use eight years earlier than planned, by 2030.

Activists did not consider this a worthy compromise. “I was shocked,” says Theo Schnarr, a PhD student and environmental activist based in Greifswald. “The coal that is lying in that area is enough on its own to burn through our whole CO_2 budget.” Watching the videos of Lützerath, Schnarr said he understood their frustration. He also felt deeply sad. But mostly Lützerath clarified how disillusioned he felt with mainstream politics—whatever party is in charge. “Lützerath demonstrated so many points so clearly,” he says. “Policymakers are not making decisions for people, but for industry.”

The 32-year-old is one of the growing number of activists gluing themselves to roads across the country—causing controversy and miles of traffic jams. He’s only been an environmental activist for a year and has already spent ten days in jail for blocking roads. “We’re pointing out with our protests that our government is not capable of dealing with this crisis,” says Schnarr, who belongs to the environmental group Last Generation, which formed in Germany around the same time the Green Party entered government. “Scientists tell us we have around three years to put in place effective actions,” says Schnarr. That means he considers the government in power right now as the country’s last chance for action.

When Green parties enter government, it’s common to see environmental groups radicalizing in response, says Daniel Saldivia Gonzatti, a protest researcher at the Berlin Social Science Centre, a research institute. “The Last Generation [protest group] formed as a by-product of Green party success entering government, because now only a radical environmental movement such as them was actually able to push a radical pro-environmental agenda further.”

Since the Finnish Green Party became the first such European party to enter a European government in 1995, green parties have been transformed from radical outsiders to mainstays of government. They are now in coalition in six EU countries: Austria, Belgium, Finland, Germany, the Republic of Ireland, and Luxembourg.

“Greens as significant coalition partners has been a seemingly increasingly prevalent story in European politics,” says Mitya Pearson, who researches environmental politics at King’s College London. Germany’s Green politicians are not the only ones who have been forced to make decisions that alienate environmentalists. Austria’s Green energy minister Leonore Gewessler also proposed replacing Russian gas with coal to get through winter—a suggestion rejected by parliament at large. In January, traffic in Vienna was brought to a halt as activists blocked roads for two weeks—threatening more protests if the government did not do more to combat the climate crisis.

Tensions between green parties and activists are likely to continue as a feature of green party coalitions across Europe, says Pearson. “The question will be how pragmatic [activists] are willing to be,” he says. “Would they tolerate some pragmatic decisions on energy policy if greens can show they are accelerating climate policy in other ways?”

Dresen, the activist, says he’s not against compromises—but he is against the party striking back-room deals with fossil fuel companies. “The main problem is we don’t have a green opposition,” he says. Without it, activists are fulfilling that role themselves, meaning under Green governments, climate protests are likely to intensify—not decrease. It’s the protester’s role to keep pushing, says Gonzatti. “The environmental movement will never say, okay, great, this is enough.”

MORGAN MEAKER *(@MORGANMEAKER) is a senior writer at* WIRED *covering European business.*

PHOTOGRAPHY: ARTIST AND ACTIVIST JOANIE LEMERCIER

Shinshu. A land of majestic nature.
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DIVER'S 200m
10
20
30
40
50

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Grand Seiko

Evolution 9 Collection SLGA015 Spring Drive 5 Days Caliber 9RA5 Diver's 200m

grand-seiko.com

MARGARET ATWOOD IS READY TO LET IT RIP

The famed writer speaks with WIRED about ChatGPT, the end of Roe v. Wade, and what's left to inspire hope

When I first see Margaret Atwood, she's bundled up: a hat over famous silver curls, long puffy coat, boots fit for her trudge over snow-piled sidewalks on a gray Toronto day. It almost made me feel bad for taking a cab to the restaurant.

The author of *The Handmaid's Tale* had strolled over to talk about her ninth short story collection, *Old Babes in the Wood*. It gives readers Atwood at her most whimsical: a snail body-swaps with a human, an alien tries to translate a fairy-tale, a seance summons the ghost of George Orwell. This varied fare is bookended by two suites of bruising stories about Nell and Tig, a devoted couple Atwood first introduced in 2004's *Moral Disorder*.

After removing all her winter gear, Atwood kicked off the conversation with a very WIRED opening line. "Did you know," she asked. "That amongst other things, I'm also a tech entrepreneur?"

WIRED: I heard you invented—was it a remote book-signing device?

MARGARET ATWOOD: Yes. LongPen. One day, FedEx showed up with a parcel, and I signed for it. I thought, why can't we use this sort of thing to sign books? The closest sort of device to what I was envisioning was used for remote surgery. So we made it. Publishing didn't quite grasp the beauty of it, but now it's used in business.

Have you secretly joined BookTok?

No, but I've heard about it. It's really young people, so I think if I went on there, they'd scream and run.

They'd be excited to see you.

I'm not sure about that. I know older business people don't like it so much, because they can't tell young people what they ought to be reading anymore.

That reminds me of one of the first questions I was going to ask you.

What's it like to be really, really old?

No!

It's more fun than you'd think.

Well, actually—expand on that.

As long as you're not actually dying or having dementia, you just have a lot less to lose. You can color a lot further outside the lines, especially compared to young people these days, in an age of anxiety. People are afraid of being beaten up by their peers on social media. They haven't been hardened in the fire. If you have been hardened, you can just let it rip.

Has your writing routine changed?

I don't have one. I never have. When you have a day job, you just stuff it in when you can, in the evenings. When you have a small child, you do it when they're down for a nap, and then at school. What is it now? Airplanes are good. But not always. Sometimes you'd rather watch the movie. *Kung-Fu Panda*, *Captain Underpants*.

Modern classics.

I would think so. But yes, routine—part of the reason I don't have one is that I'm so old, I didn't go to creative writing school, because there were hardly any back then. That meant nobody told me to specialize. Are you a novelist, a short-story writer, a poet? Nobody said you should choose.

Tell me your Orwell story.

INQUE magazine said pick whatever dead writer you want to have a conversation with. Orwell was pretty obvious for me, because he was an influence on my work. Plus, he ruined my young life. I read *Animal Farm* without knowing it was an allegory about the Soviet Union. I thought it was really going to be about animals, like *Wind in the Willows*.

People compare *Nineteen Eighty-Four* to Aldous Huxley's *Brave New World*.

Yes, in the 80s and 90s, we had a contest going, which was going to win? The answer was: Why not both?

Do you feel like one of your dystopian worlds is more accurate right now?

Well, right now, *The Handmaid's Tale* is. But that will change.

Should we be hopeful about the future?

Hope is built in. Human beings have hope. If they didn't, they wouldn't get up in the morning. You got up today and you thought: I hope we all have a nice life.

Have you delved into ChatGPT?

I think we could fix all this anxiety by making it mandatory to have a seal on everything generated by ChatGPT.

Do you think it's over-hyped?

Orwell already thought it out. Machines that turn out trashy literature for the masses? *Nineteen Eighty-Four*!

Are there questions you've been waiting for someone to ask you?

Questions have changed a lot over the years. Nobody asks me anymore, "Why do you hate men?" They do ask a lot about hope now, which feels significant. It's on peoples' minds. Is it all done for? No! That's why I did Practical Utopias. It was a hopeful project. Do you know about the Future Library of Norway?

Is that where you wrote a book to be read in the future?

Well, we don't know if it's a book. We know it's made of words. There were two strictures: It has to be made of words, and you can't tell anybody anything else.

And you feel confident people will read it in a hundred or so years?

I don't care. I'll be dead. But, it's a very hopeful project, because it assumes

Margaret Atwood—celebrated novelist, poet, critic, and occasional technology entrepreneur.

PHOTOGRAPHY: DEREK SHAPTON

that there will be people, there will be a Norway, that the library will still exist.

One of your stories features an academic remarking on the "snake pit" of gender discourse. Do you still worry about the snake pit of the internet, or do you feel immune?

Nobody's immune to anything. You have to understand the different kinds of pressures people feel like they're under. What do totalitarian governments of any kind try to do immediately? They try to control communications networks. In a coup, they grab the radio and television. They try to shut down communications, and education, so that nothing is taught that isn't copacetic with their own views. A third thing is to control the judiciary, so the views of the judges and lawyers are the same as the regime. This is an old playbook.

It's a struggle to feel hopeful.

I am not counting the United States out. It's a diverse country with a lot of ordinary people fighting back. The Midterms. Overturning Roe v. Wade was not a smart move.

I assumed there'd be a Women's March-style outpouring into the streets.

What you need right now is grassroots, block-by-block, constituency-by-constituency organization. To say, here's other things people want to take away from you: women's health care, Medicaid, Social Security, the education of your child. The left has not been smart. They should have shown some support for freedom of expression, whereas in fact they rolled their eyes and said that's a tool of the right. It didn't start out that way. In the history of the United States, it was actually the union movement.

I haven't actually seen many lefties sneering at freedom of expression. Is there an example that leaps out?

May I quote Elizabeth Barrett Browning? "Let me count the ways." So that's your job, you can have a look. Some of us signed that *Harper's* letter calling for more reasonable discourse and got shouted at a lot from the left. "No, we don't want to do that. We just want to denounce people." That's just a gift to the right. The center has to repel the extremist hordes on both sides.

People on the left are criticizing the *Harper's* letter, sure. But people on the right are banning books.

A lot of the impulses are the same.

I hope that's not true.

Chairman Mao? Joseph Stalin?

Do you think they were really leftists?

Not if you mean the nice people you know who want things to be fairer. But if you mean the flags they were flying, yes. Look at the early history of the USSR. Very communitarian, equal rights for women. That got shut down very quickly. Early Christianity was also very communitarian. And then what happened? These things go in cycles.

Are we doomed for everything progressive to be met with reactionary forces?

I don't like the term progressive. It assumes there's a Yellow Brick Road that leads to a city of Oz that doesn't exist. I prefer to say fairer. Can things be fairer? Yes. Will it take work? Yes. Do you get to just call yourself progressive and pat yourself on the back? Not in my book. Plus, the eugenics movement, which caused a lot of women to be sterilized, was thought of as a progressive thing. So let's do a little rearranging of the language that doesn't come with that baggage. Fairer—I like that.

This interview was edited for brevity.

KATE KNIBBS *(@Knibbs) is a senior writer at* WIRED, covering culture.

THE REAL-WORLD HOLLYWOOD HIT MEN

The Matrix movies brought together Keanu Reeves and Chad Stahelski. Now the singular duo have reunited for a fourth instalment of John Wick—but the war against the machines still plays a big part in their working relationship

WIRED: I have to know, Chad, what was it like to play "Chad" in *The Matrix Resurrections*?

CHAD STAHELSKI: Oh my God. I will tell you, that was not my best day.

KEANU REEVES: It was a fantastic day.

STAHELSKI: I thought it was going to be no big deal. I think I knocked over the coffee stand. I had a croissant in my mouth. I flubbed my lines. It was tragic.

REEVES: Lana [Wachowski] thought you were perfect for the role.

Is it fair to say the John Wick franchise owes a debt to the *Matrix* movies?

REEVES: If we're gonna compare them, they both were original ideas with visionary filmmakers.

STAHELSKI: No one was under any delusion that *Matrix* wasn't going to be pretty awesome. Then David Leitch [codirector of the first *Wick* film] and I stayed on for *V for Vendetta* and *Speed Racer*, so we pretty much got a decade of Wachowski film school. The *John Wick*s are definitely children of *The Matrix*.

As an actor, what's it like working with the Wachowskis? I interviewed Eddie Redmayne when he finished *Jupiter Ascending* and remember him saying Lana's direction was often things like, "Play it like an accountant!"

REEVES: Um, I never got that kind of direction.

What did you get from them?

REEVES: Attention to detail, world-building, and having ideas as nourishment in your entertainment. That exists in *John Wick 4* too—the idea of freedom, the idea of choice with rules and consequences. How are you trying to break out of the system? *John Wick* has got a cool thing because everyone is bad. They're bad people. But they're also super moral and ethical. Well, not even ethical, but there's a code. You root for John Wick.

Which is extra impressive, considering that he's not some known IP. He's an original creation.

STAHELSKI: It's kind of cool, like, you don't have 60 years of Batman to work from. You don't get that to lift you up, but at the same time you don't have it to hold you down. Nothing's holding us back.

You don't have a Reddit thread of people scream-typing, "This isn't canon!"

REEVES: We've developed our own playground.

STAHELSKI: We just went with a bunch of ideas we loved. But we didn't go out with an agenda.

REEVES: Yeah, we did. We went out with your agenda of action as part of storytelling. And character. That was the fundamental base.

And on top of that, a commitment to minimal special effects?

STAHELSKI: We're not, like, at war with VFX. It's super handy, it's a great tool. But you can't beat the blood, sweat, and tears of real people.

REEVES: When you watch *John Wick* action scenes, it feels different. There's so much choreography. It's on the edge.

STAHELSKI: And sometimes what we have in our heads doesn't work, so we have to change it. You can't rehearse 40 cars driving around in a parking lot, you gotta get it on the day. You don't know what's going to happen, so there's a little desperation. Some of the best moments we've had in all four movies are—if not accidental, they're incidental. It's the imperfection that makes it special.

Speaking of incidentals in *John Wick*, those coins the hit men use. They look a lot like bitcoins, but Bitcoin wasn't very big when you made the first movie.

STAHELSKI: [Laughs] We're going to take credit for that.

It's kind of ironic how it's the cryptocurrency of this underworld. In the real world, crypto is having a tough time.

REEVES: I think the principle, the ideas behind an independent currency, are amazing. These are amazing tools for exchanges and distribution of resources. So to pooh-pooh crypto, or the volatility of cryptocurrency, it's only going to make it better in terms of how it's safeguarded.

Do you guys love science fiction?

STAHELSKI: I'm always big on sci-fi. Like, *John Wick* is hyperreal. But it's also got this analog sense. Old computers, old suits, old stuff.

REEVES: I'm interested in the storytelling of humans and their interactions with technologies.

Keanu, years ago you put a clause in your contracts saying that your performances couldn't be manipulated without your say-so?

REEVES: Yeah, digitally. I don't mind if someone takes a blink out during an edit. But early on, in the early 2000s, or it might have been the '90s, I had a performance changed. [He won't say which.] They added a tear to my face, and I was just like, "Huh?!" It was like, I don't even have to be here.

What do you think of deepfakes?

REEVES: What's frustrating about

→ Chad Stahelski codirected Keanu Reeves' first *John Wick* movie, and directed the next three.

PHOTOGRAPHY: ART STREIBER

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that is you lose your agency. When you give a performance in a film, you know you're going to be edited, but you're participating in that. If you go into deepfake land, it has none of your points of view. That's scary. It's going to be interesting to see how humans deal with these technologies. They're having such cultural, sociological impacts, and the species is being studied. There's so much "data" on behaviors now. Technologies are finding places in our education, in our medicine, in our entertainment, in our politics, and how we war and how we work.

***The Matrix* just looks more and more wildly prophetic by the day. AI doesn't control our lives yet, but ...**

REEVES: [in his best Agent Smith voice] They started making decisions for you. It became our world. I was trying to explain the plot of *The Matrix* to this 15-year-old once, and that the character I played was really fighting for what was real. And this young person was just like, "Who cares if it's real?" People are growing up with these tools: We're listening to music already that's made by AI in the style of Nirvana, there's NFT digital art. It's cool, like, Look what the cute machines can make! But there's a corporatocracy behind it that's looking to control those things. Culturally, socially, we're gonna be confronted by the value of real, or the nonvalue. And then what's going to be pushed on us? What's going to be presented to us?

The metaverse!

REEVES: It's this sensorium. It's spectacle. And it's a system of control and manipulation. We're on our knees looking at cave walls and seeing the projections, and we're not having the chance to look behind us. Or to the side. I'm sorry to go on here, Chad.

STAHELSKI: No, it's great.

REEVES: It's also a fascination—it seems for us, the animals on the planet, like, How do we defeat death? How do we change the weather? How do we replace nature?

Should I be worried about AIs coming for my job?

REEVES: The people who are paying you for your art would rather not pay you. They're actively seeking a way around you, because artists are tricky.

We push back, we have our own ideas.

REEVES: People in power don't want that, you know? So that's not your lifetime, that's like your next birthday. And before then, they're going to challenge how much they pay you. So everyone's gonna be an independent worker. Look at all the independence you have! Let's not have unions.

WIRED in the US just unionized.

REEVES: That's cool. See how long that lasts. Fingers crossed.

But yeah, in the meantime, now ChatGPT can write scripts that are just combining other ideas.

REEVES: Which is cool, because that's what artists do, right? We take

↓

Reeves and Stahelski are reuniting for a further *John Wick*-adjacent film: *Ballerina*, which explores a character from *Chapter 3*.

→

Keanu Reeves and director Chad Stahelski wanted to film highly choreographed action sequences, rather than use digital effects.

↘

Reeves and Stahelski met while Stahelski was Reeves' *Matrix* stunt double. Laurence Fishburne joined *Jop Wick* in *Chapter 2*.

our influences and we synthesize them. But what's the intention behind that synthesis?

STAHELSKI: I'm all for the tools. It's just, we want to control the choice behind it. We had AI-produced digital art for some background stuff in *John Wick*. The younger staff are into that world, and they were like, "Hey, this would be cool. Let's try it."

Keanu, you recently became an adviser to the Futureverse Foundation, which is focused on diversifying the metaverse. How did you get involved with that?

REEVES: It's something my partner, Alexandra Grant, is really interested in, so I'm kind of riding her coattails. I helped set up the launch. We're trying to take this technology that people are interested in and give opportunities to artists with different viewpoints.

When you look at a company like Meta, which has made building in the metaverse a priority, the entry points aren't accessible to a lot of people.

REEVES: It's like they've created more land. There's more land for sale. It's wealth creation and it's opportunity.

But I have to believe in-person experiences are here to stay. The release of *John Wick: Chapter 4* got delayed because of Covid-19. Was it important to you to release it theatrically?

STAHELSKI: Maybe it's our generation, but I like seeing a movie in the cinema. Even if it's meant for streaming eventually. It's a different experience.

REEVES: It's dreams, right? And immersion. I think the power of cinema—part of it is its novelty, but also scale. You see a close-up of a wonderful performance with emotions and storytelling that touch you. Whether it's horror or action or comedy, you're seeing a face that's, you know, 20 feet tall. Yeah. You're, like, there. The intimacy of that.

It seems like people often project a lot onto their heroes online. Is it weird being internet-beloved?

REEVES: It's nice when it's nice, but I'm sure it's super horrible when it's horrible.

Well, there were people who made mods to have sex with your character in *Cyberpunk 2077* …

REEVES: Getting it on with Johnny Silverhand?! I hope it was good. I'm sure Johnny tried hard.

STAHELSKI: I'm sure he gave it his best …

REEVES: If he cared. [Laughs] He's kind of bitter.

STAHELSKI: Emotionally empty.

REEVES: He's not emotionally empty. He cares so much, and the world's so corrupt and he's just trying to get some back!

Do you have a favorite Keanu meme?

REEVES: No. I don't seek them out. Once in a while people show 'em to me when they're fun.

STAHELSKI: Keanu with the sandwich is probably my favorite. Sad Keanu!

REEVES: The original!

On that note, we need to wrap up. I guess this is the time to say "Be seeing you."

REEVES: It's always fun when I'm out and people say, "Hello, Mr. Wick."

How long before that was it people saying "Hello, Mr. Anderson"?

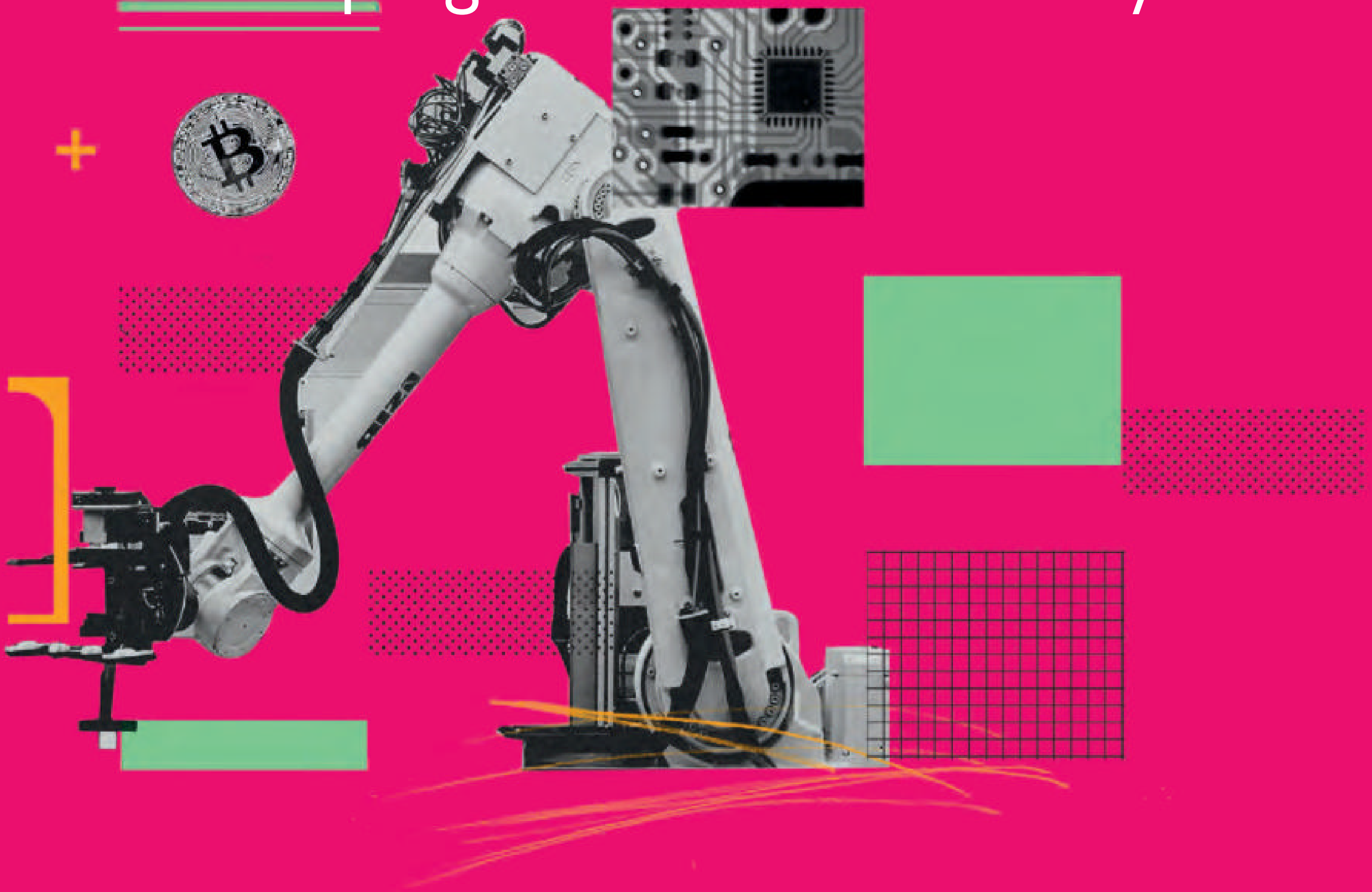
REEVES: Oh, I still get that.

This interview has been condensed and edited for brevity.

ANGELA WATERCUTTER *(@WaterSlicer) is a senior editor for* WIRED *covering pop culture.*

PHOTOGRAPHY: ART STREIBER. STYLING BY JEANNE YANG. STYLING ASSISTANCE BY CHLOE TAKAYANAGI AND ELLA HARRINGTON (KEANU), EMILY DIDDLE (CHAD). GROOMING BY KERRI SMITH FOR SCHNEIDER ENTERTAINMENT (KEANU), JENI CHUA FOR EXCLUSIVE ARTISTS USING KEVIN MURPHY (CHAD). SUIT BY BRIONI, T-SHIRT BY JAMES PERSE, SHOES BY MAGELLAN & MULLOY (KEANU, OPENER AND PREVIOUS). SUIT BY BROOKS BROTHERS, T-SHIRT BY HERMES, SHOES BY JOHN VARVATOS (CHAD, OPENER AND PREVIOUS)

Emerging technologies are constantly disrupting the financial services sector, but they also offer enormous opportunity. WIRED Money will bring together decision makers and tech-curious individuals for a half-day live event showcasing some of the leading minds in finance, as they reveal the trends shaping the future of money.



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Some products are so well made they transcend trends to become exemplars in their class. From timeless designs to the virtually indestructible, and the infinitely repairable to the endlessly playable, we encourage you to buy these once, then use them forever…

Duralex Le Picardie Glassware ▼ Originating in France in 1927, Duralex glasses are a true, heat resistant, virtually unbreakable classic. Sadly, the matching carafe here was discontinued, but WIRED's own 15-year-old set is a testament to its design and durability. *£18 for six heals.com*

Edited by **Jeremy White**
Words by **Chris Haslam**
Photography **Wilson Hennessy**

1. COOL

TOLIX H45 Stool ▼

Ever been to a café in France? Then you've likely sat on a TOLIX. Based on Xavier Pauchard's 1934 TOLIX H chair, the stackable TOLIX H stool was designed for factory workers, and they're still in production today. Sourced by Merchant & Found, these hardy specimens in a beautifully patinated orange are a staggering *70 years old*, yet still play nicely with ones fresh off the production line. *Original 1950s Tolix H45, £695 for three merchantandfound.com*

VINTAGE TOLIX H45
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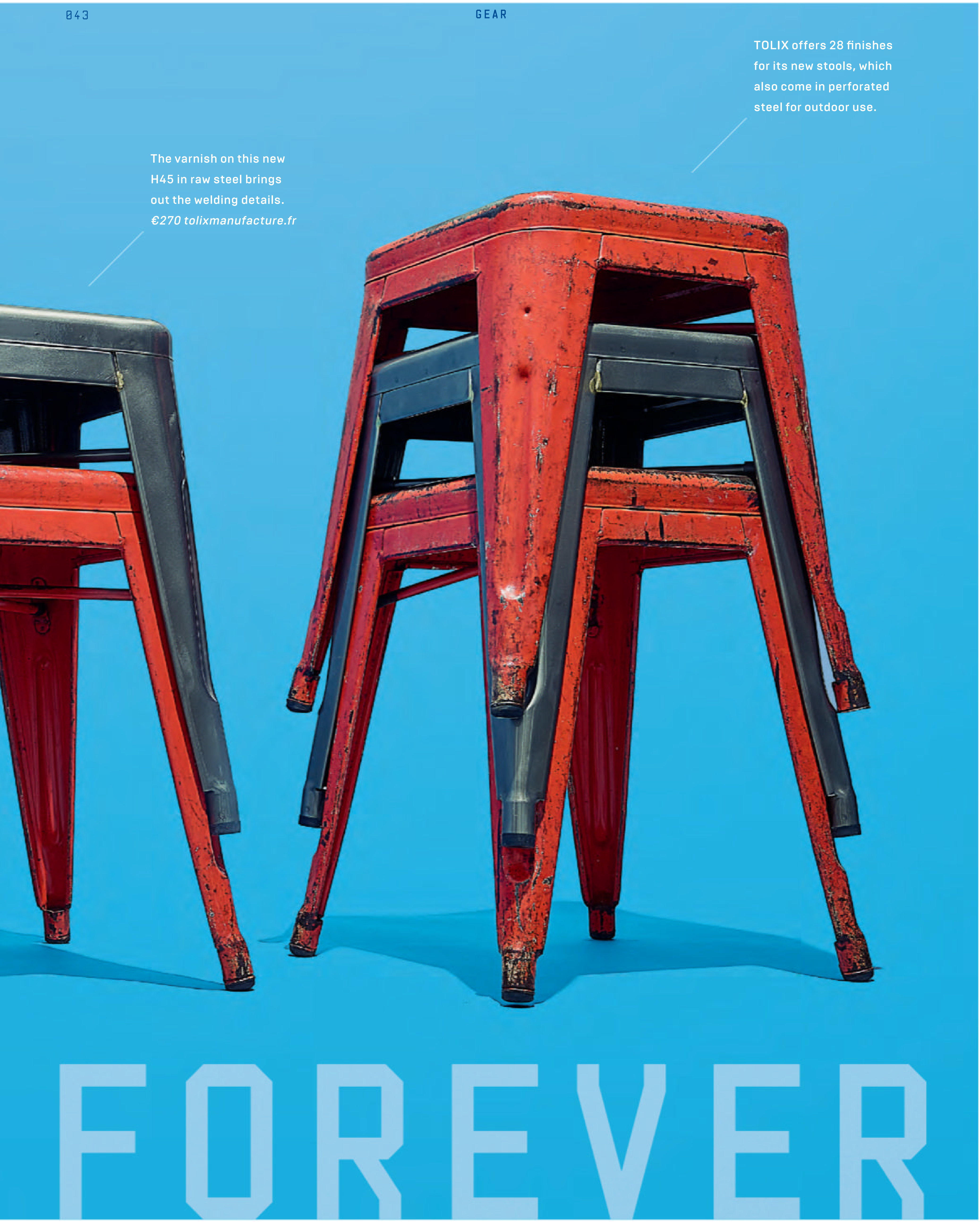
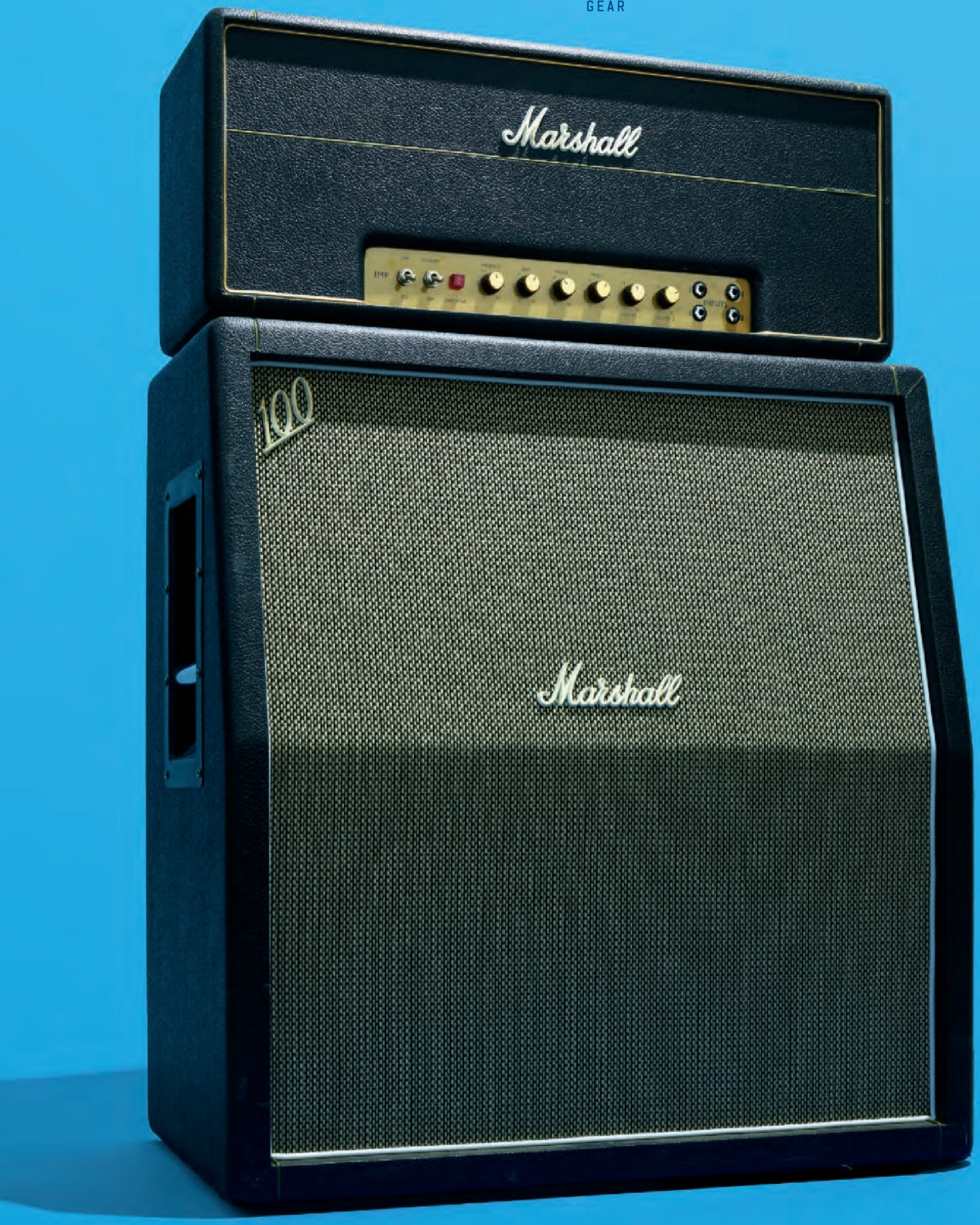
TOLIX H stools come in eight heights, while forms include armchairs and high-backed bar perches.



TOLIX offers 28 finishes for its new stools, which also come in perforated steel for outdoor use.

The varnish on this new H45 in raw steel brings out the welding details. *€270 tolixmanufacture.fr*

FOREVER

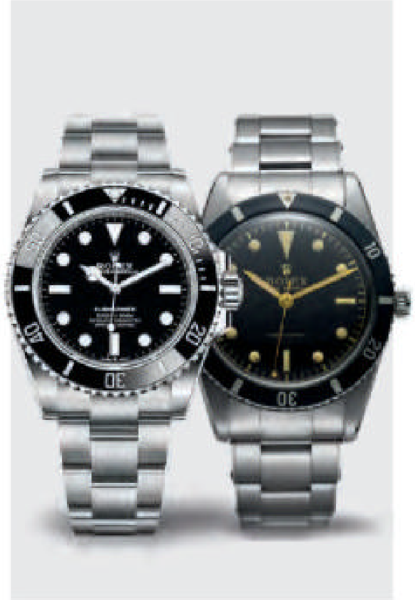


Marshall 1959HW head and 1960AHW cab ▲
Considered by many to be the “holy grail” rock amp, the 1959HW head has a lineage that goes right back to the 1960s. Indeed, the original was created after The Who’s Pete Townshend asked “The Lord of Loud” Jim Marshall if he could “make it louder”. This reissue delivers the classic, hand-wired, all-tube vintage Marshall tone that made them collectors’ items in the first place, while crucially still using authentic parts and construction methods. Based on a pre-July 1969 SL/A head, tone controls manage bass, middle, treble, and presence, while the 120 Watt 1960AHW angled-face cabinet matches the head with its salt-n-pepper grille cloth, metal handles, and reissued Celestion G12H30 speaker. Just remember, the louder you play, the better it sounds. *£POA marshall.com*

MARSHALL 1959HW HEAD
ROCKING SINCE THE 60S

Moccamaster KBG Select ▼

The Moccamaster has been handmade in the Netherlands since 1968, and makes a delicious cup (well, four to 10 cups to be precise) of filter coffee. The secret lies in the heating element, which maintains an optimal brew temperature of between 92°C and 96°C to help produce a smooth, flavorful drink with none of the associated bitterness. It's fully repairable, available in some cool colors, and is completely recyclable. *€231 moccamaster.eu*



Rolex Submariner ▲

The original Bond watch is 70 years old, yet remains faithful to its early design (*above-right*). Famously the first divers' wristwatch waterproof to 100m (330ft), today's Submariner (*above-left*) is happy down to 300m (1,000ft). Its unfussy "no-date" iteration will be going strong and looking the business well beyond your lifetime. *£7,700 rolex.com*

ZeroLab Electric 1969 Ford Bronco ▲

LA-based ZeroLab is perfecting the art of converting classic cars to EV, and its transformed 1969 Ford Bronco fuses technology with timeless style. This full restoration includes a carbon-fiber body, and an all-electric drivetrain. Powered by a 100-kWh battery pack, the Bronco has a pair of electric motors producing a combined 600 horsepower and delivering a claimed range of up to 235 miles. *$350,000 zerolabs.com*

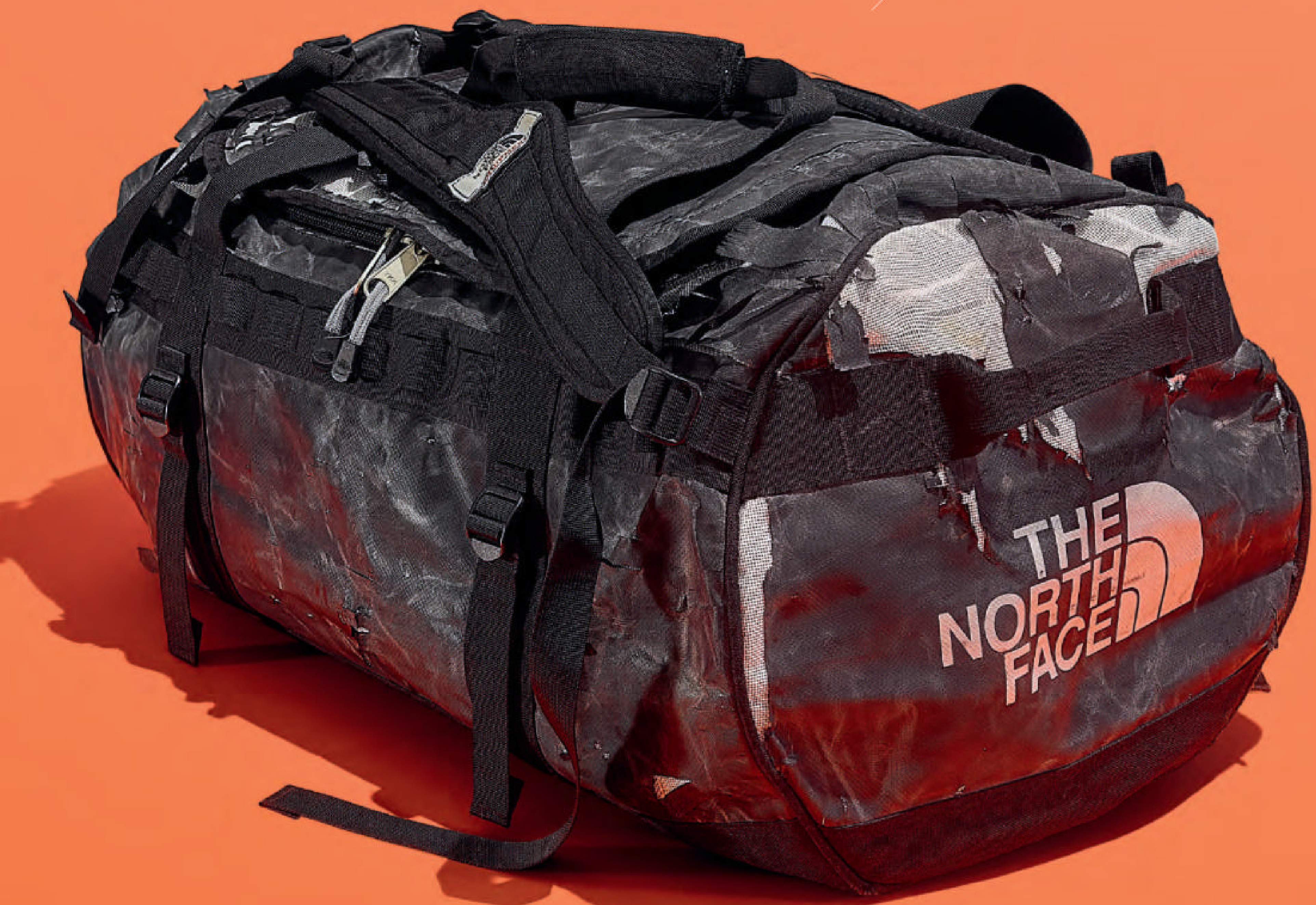
Adidas Copa Mundial ▼

Designed for the 1982 FIFA World Cup in Spain, the Copa Mundial boot remains perennially popular—quite the accolade, given all the hyperlight, 3D-printed, micro-chip performance-analyzing tech being used today. The classic firm ground K-leather boot (that's K for kangaroo) has been upgraded over the years, and has been worn by such legends as Zinedine Zidane, Diego Maradona, Gary Lineker and Eric Cantona, and remains the official boot for officials in leagues all over the world. *£130 adidas.com*

Vitsoe 606 Universal Shelving System ▲

While Swedish couple Nils and Kajsa Strinning conceived the versatile String shelving system in 1949, it's Dieter Rams' deliberately "timeless" 1960 design for the 606 shelving unit that tops our modernist wish list. The system, manufactured by Vitsoe, has been in production ever since, and is based around the versatile E-Track setup that can be wall-mounted, semi-wall mounted, or fitted to ceiling and floor, and then adorned with a wide collection of interchangeable shelves, cabinets and tables. And, because the design hasn't changed in decades, a 50-year-old shelf unit will slot in perfectly with those just out of the factory. *£POA vitsoe.com*

2.



Should Jeremy's bag ever become unusable and unrepairable, The North Face will salvage what it can for reuse or recycling.

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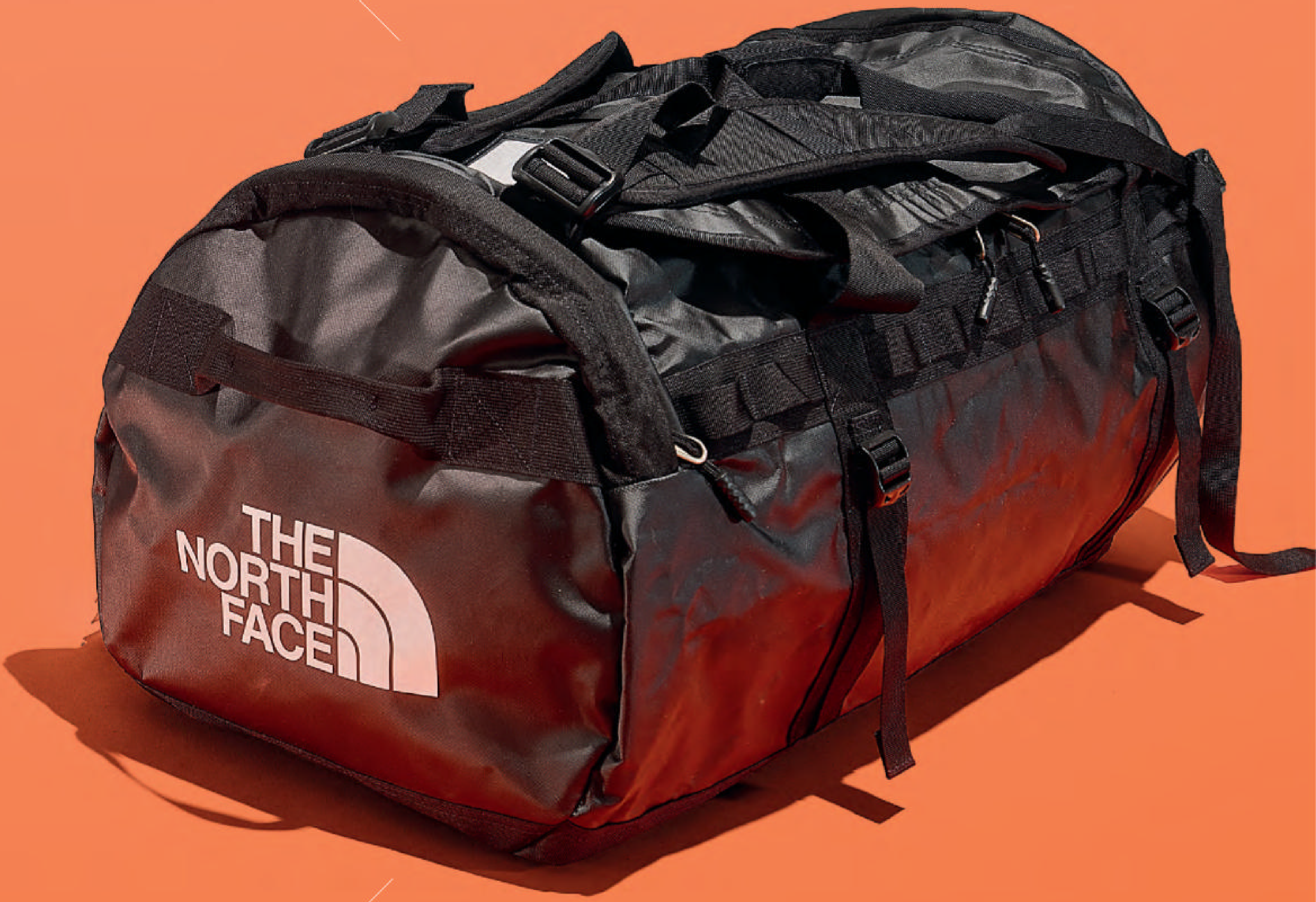


The extra-wide luggage straps distribute weight for carrying heavier loads.

Sizes run through 50, 71, 95, and 150 liters, and all can be carried in hand or worn as a backpack.

The North Face Base Camp Duffel ▲
Gear editor Jeremy White has been dragging his trusty The North Face duffel around for 23 years, packing in ski boots, helmet, and a week's worth of outerwear and evening clothes without bursting—and his bag is certainly easy to spot on the luggage carousel. The latest iteration features the same robust build, but has been upgraded with phthalate-free, recycled PVC and recycled nylon that's treated with a non-PFC water repellent (DWR) finish. Got a veteran like ours? The North Face also repair "pre-loved" versions to keep their adventures going. *From £105 thenorthface.com*

3. Le Creuset 3-Ply Stainless Steel Saucepan Set ▼
Managing editor Mike Dent has been enjoying these very 3-ply stainless steel pans for the past 8 years, and proves there is life after Teflon. The set includes 16cm, 18cm, and 20cm pans, all of which offer fast and even heat distribution, and are infinitely scrubbable. *£405 lecreuset.co.uk*

1. YETI Roadie Cooler + 2. YETI Tundra Cooler ▲
When camping season comes around, we're always asked if YETI's hard coolers are "worth the money", and while value is subjective, we can't fault their ability to keep our drinks cool, even in the most extreme situations. (We've seen videos of charred and melted Yeti coolers pulled from truck and house fires, with still-cold beer safe inside!) Made using rotomolded rigid plastic with pressure-injected polyurethane insulation, the cold will not prematurely escape (unless you leave it open), and they've even been certified as "bear proof" by the wonderfully titled Interagency Grizzly Bear Committee (IGBC). *YETI Roadie, £200; Tundra 45, £300 yeti.com*

Stokke Tripp Trapp ◀
A true icon of versatility, the Tripp Trapp was created in 1972 by Peter Opsvik. The height-adjustable beech- and oak-ply chair flexes to fit children, from babies to adulthood, with the angled form and large footplate enabling the user to get close to the table. Simple, effective, and robust. *From €239 stokke.com*

4. Henry HVR200-22 ▼

This tough Henry vacuum cleaner is 18 years old, and, thanks to the 10m-long cable, has bounced up and down the stairs of a tall townhouse without complaint. Henry does lack the bells and whistles of battery-powered and bagless rivals, but the availability of spare parts makes him affordable and highly repairable. *£129 myhenry.com*

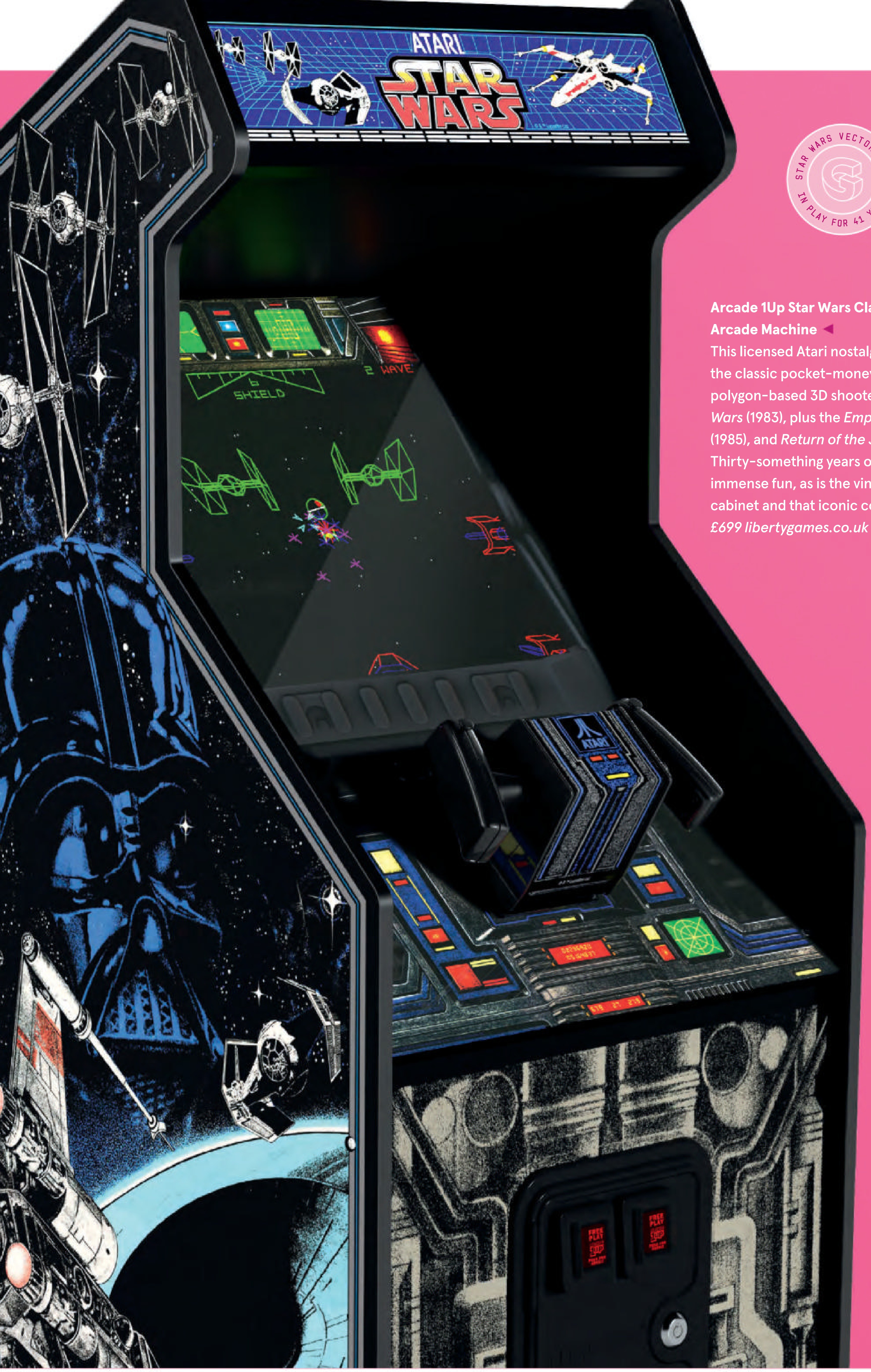
HENRY HVR200-22
18 YEARS OF SERVICE

Linn Sondeck LP12 ►

Largely unchanged since 1972, the LP12 is modular, upgradeable, and constantly evolving. The £3,700 entry-level Majik buys you into the family, but from there you can keep tweaking it forever, such as adding the new flagship Ekstatik cartridge, a princely £6,050 just on its own. *From £3,700 – £25,000+ linn.co.uk*

5. Rimowa Classic Cabin ▲

Serving its owner since 2014, on the rare occasion this aluminum icon has been checked in, it's come out the other side with only a few (sexy?) battle scars. The wheels are still silky-smooth, but if they do break, Rimowa sells swap-ins in popping colors, to further burnish your case's unique patina. *£1,050 rimowa.com*



STAR WARS VECTOR GAME IN PLAY FOR 41 YEARS

Arcade 1Up Star Wars Classic Arcade Machine ◄
This licensed Atari nostalgiafest features the classic pocket-money-sapping, polygon-based 3D shooter that is *Star Wars* (1983), plus the *Empire Strikes Back* (1985), and *Return of the Jedi* (1984). Thirty-something years on, they're still immense fun, as is the vintage-style cabinet and that iconic control yoke.
£699 libertygames.co.uk

3. PLAY FOREVER

LEGO Atari 2600 ▼
This loving recreation of the classic games console is aimed squarely at AFOLs who get misty-eyed at the thought of long hours playing *Centipede*. Yes, it's basically a wood-grain-effect box, but LEGO has thoughtfully upped the fun with a hidden interior of an early-80s gamer's bedroom, plus a joystick and some game carts, with mini-dioramas based on their artwork. *£209 lego.com*

Adventure came out in 1979, and features the first in-game Easter Egg—a name credit for its creator.

ADVENTURE
POWER
OFF
COLOR
B-W
GAME SELECT
GAME RESET
ATARI

CONTROLLERS
OSCILLATOR BANK
MIXER
MODIFIERS
OUTPUT

Minimoog Model D Reissue ▼
Originally released in 1970, the ease of use, portability, and unique sounds of the Minimoog Model D has inspired everyone from Kraftwerk to Gary Numan to Dr. Dre, and now a new generation can be seduced by its analog wiles. This reissue, housed in an Appalachian cherry cabinet with hand-finished aluminum chassis, retains the exact component placement and through-hole design of the original, but has a spring-loaded pitch wheel for improved playability and added MIDI functions to make modern studio integration easier. *£5,290 moogmusic.com*

MINIMOOG MODEL D
53 YEARS OF KNOB-TWIDDLING

The knobs and switches remain faithful to the original Model D.

FILTER MODULATION
CUTOFF FREQUENCY
FILTER EMPHASIS
AMOUNT OF CONTOUR
VOLUME
MAIN OUTPUT
ATTACK TIME
DECAY TIME
SUSTAIN LEVEL
A-440
POWER
KEYBOARD CONTROL
OVERLOAD
LOUDNESS CONTOUR
PHONES
WHITE
PINK
MODIFIERS
OUTPUT
moog MUSIC INC. minimoog

Top Trumps ▶
This staple of playgrounds everywhere is often controversial—how in blazes Jar Jar Binks was able to beat Yoda in the *Phantom Menace* pack set still upsets us—but always entertaining. Top Trumps, made in the UK for the past 40 years and sold globally, has the unrivaled ability to gamify everything from rock formations and diggers, to NFTs, Disney Princesses, and *Peaky Blinders*. The key to its enduring appeal? Secretly, everyone *loves* statistics… *£8 toptrumps.com*

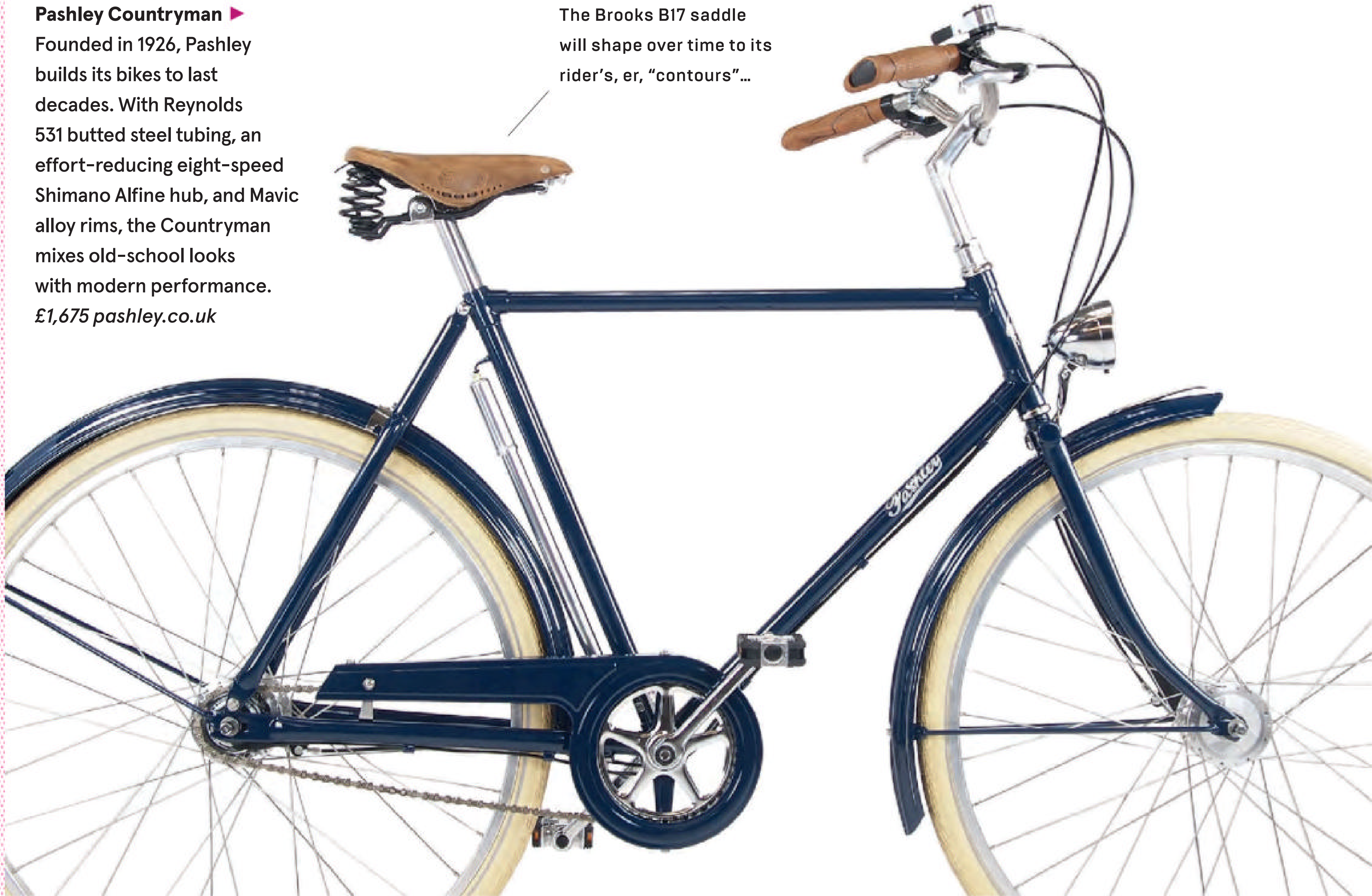
NFTs
TRAINERS
TOP TRUMPS
#TRENDING
TOP TRUMPS
#TRENDING
30
OTIS

GKD Mini Retro Game Console ▲
Scratch that vintage gaming itch with the GKD Mini, which packs in 15 emulators and 20 simulators, plus a MIPS 32 CPU with 1.5GHz, 128MB RAM, and has 2,500 retro games loaded and ready to play. Its on board 32GB is upgradeable to 512GB via MicroSD slot, but don't stray too far from a plug socket—the battery only lasts 6 hours. *$109 game-kiddy.com*

BRIO
H20
H20-021

BRIO Battery Operated Steaming Train ◀
A BRIO train not made of beech wood?!? Unclutch those pearls, middle-class parents, there's a good reason. While still compatible with BRIO sets made since 1934, this one tows a water tank that lets it puff out "steam"—press the forward or reverse button, and it'll tootle along, headlights on and chimney blowing. *£39.99 brio.co.uk*

Pashley Countryman ▶
Founded in 1926, Pashley builds its bikes to last decades. With Reynolds 531 butted steel tubing, an effort-reducing eight-speed Shimano Alfine hub, and Mavic alloy rims, the Countryman mixes old-school looks with modern performance. *£1,675 pashley.co.uk*


The Brooks B17 saddle will shape over time to its rider's, er, "contours"…

4.

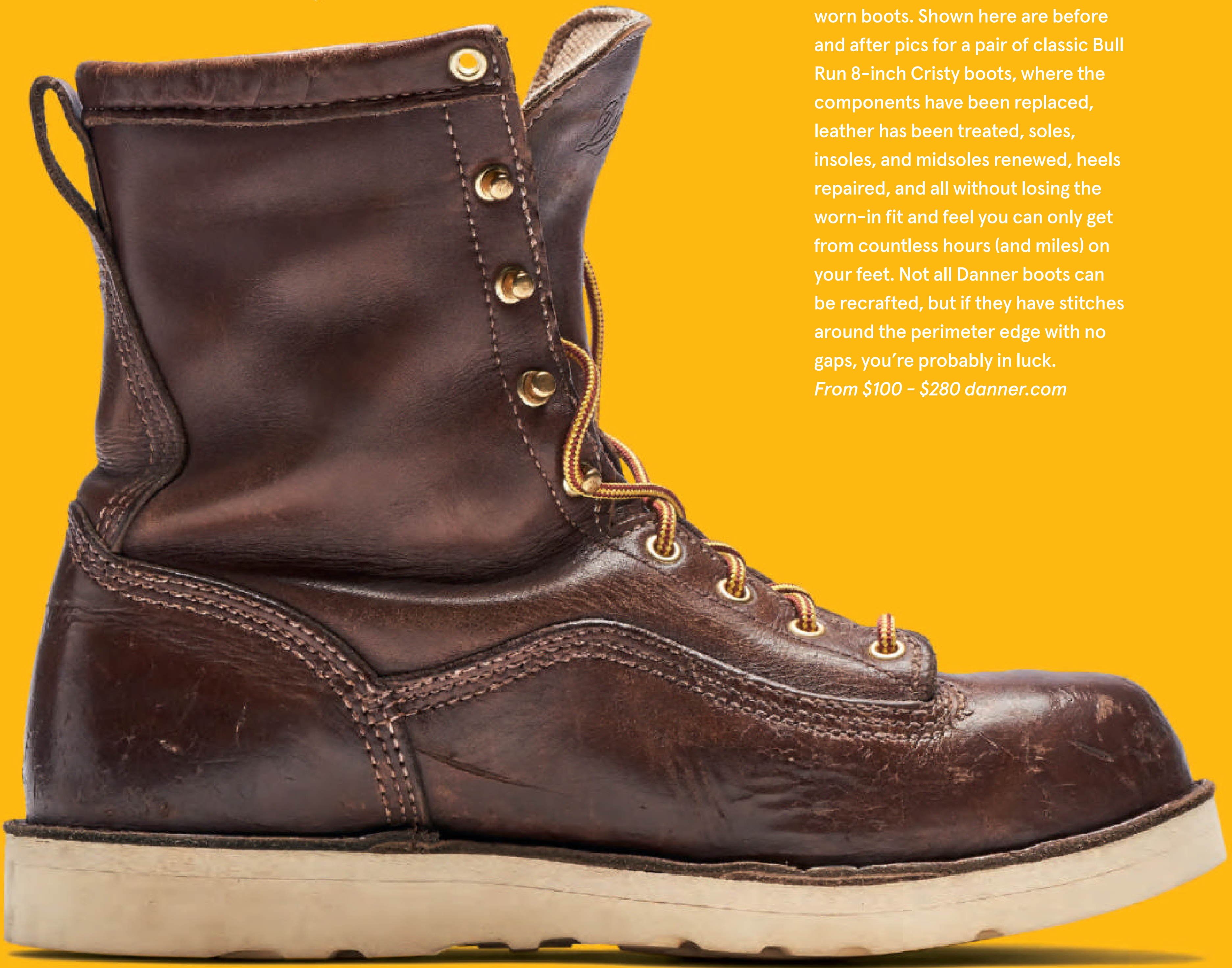
The Danner Wedge outsole is designed for hard indoor surfaces, and is non-conductive.

DANNER BULL RUN BOOTS
70-YEAR-OLD DESIGN

The Danner Bull Run boot goes back to 1932, and it's still a favorite with workers who spend long hours on their feet.

REPAIR

After spending 5-6 weeks in the care of Danner's specialists in Portland, Oregon, your boots will be restored to life once more.



Danner Boot Recrafting ▼
Getting your shoes resoled used to be the norm, but in the pursuit of lightweight materials and podiatric performance, many brands missed the memo on repairability. Thankfully, Danner has an entire team employed to transform well-worn boots. Shown here are before and after pics for a pair of classic Bull Run 8-inch Cristy boots, where the components have been replaced, leather has been treated, soles, insoles, and midsoles renewed, heels repaired, and all without losing the worn-in fit and feel you can only get from countless hours (and miles) on your feet. Not all Danner boots can be recrafted, but if they have stitches around the perimeter edge with no gaps, you're probably in luck.
From $100 - $280 danner.com

FOREVER

Levi's Type III Jacket ▼

Introduced in 1962 and worn by Elvis, John Lennon and half the cast of *The Breakfast Club*, no other denim jacket is as iconic. Be it modern or vintage, it's a wardrobe staple. Now, thanks to London concept store Levi's Haus, no matter how threadbare your denim, the brand will reimagine, repair or recycle it using in-store tailors and innovative collaborations. *£POA levistrauss.com*

Dualit Classic 4 Slice Newgen Toaster ▲

Every Classic Dualit toaster is hand-assembled at its factory in West Sussex, and because the product was conceived to cope in commercial kitchens, they're impressively robust and refreshingly reparable. You've got two choices if your toaster fails: You can either send it back for a quote and full repair, or, if you fancy yourself with a screwdriver, Dualit sells key spare parts including heating elements and timers, with prices from just £3.60 for a new control knob. *£169 dualit.com*

Naim Nait 1 ▲

There's nothing new to see here, although a reissue of Naim's 1983 revolutionary "affordable" integrated amplifier with chrome bumper chassis would go down a storm in 2023. Instead, we're showcasing the 40-year-old design to illustrate how most Naim products (excluding the MuSo streaming speakers) can be repaired or serviced in its Salisbury factory. Naim holds stock of all key components, and has even been known to 3D print broken knobs for long-deleted designs, which goes some way to explain why its pre-owned systems retain such high market prices. *naimaudio.com*

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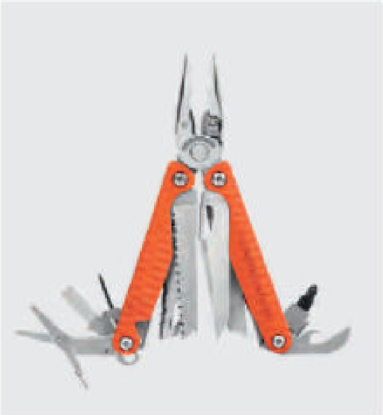

+

Trusco ST-350-B Toolbox ▲

Designed by Keiyu Hisashi in 1947, the Trusco Toolbox is still made in Japan by Toyo Steel, to exacting levels of quality workmanship. Blue, of course, is the classic—and only—color for the Trusco iteration, and once cantilevered out, you'll find roomy center storage big enough for hammers and spanners, while on the sides, a series of containers, dividers, and clutter controllers keep all your piles of assorted screws, rawlplugs, drill-bits and IKEA pencils in check. *£89 amazon.co.uk*

Leatherman Charge+ G10 ▲

An essential in every toolbox, this Leatherman has interchangeable wire cutters that can be removed, sharpened or replaced, two CPM S30V steel blades, a file, and a saw—all of which are accessible from the outside, without opening the handles. Inside, there's a screwdriver, bottle/can-opener, bit holders, scissors and pliers. *€249 leatherman.com*

PB Swiss Tools 2212 LH RB ▲

Not only is this set of hexagon socket screws aesthetically pleasing and beautifully color coded, but the combination of 100° angle and ball-point ends makes it considerably easier to access hard-to-reach screws and bolts. Each is made from an alloy based on that used to manufacture steel springs, combining both durability and elasticity. *€86 pb-direct.eu*

Barbour can patch holes, replace missing bits, and re-wax your trusty jacket, to bring it back to life.

Barbour Wax for Life ▲
During November and December 2022, Barbour's South Shields repair center in the North East of England re-waxed 4,233 jackets. Barbour also estimates 60,000 jackets are re-waxed globally through its service centers each year. But it's by no means a new service: Barbour has been re-waxing its classic cotton jackets for more than 100 years, helping to maintain performance and extend product life—and it sells 100,000 tins of wax to customers who like to top up their jackets themselves. *£POA barbour.com*

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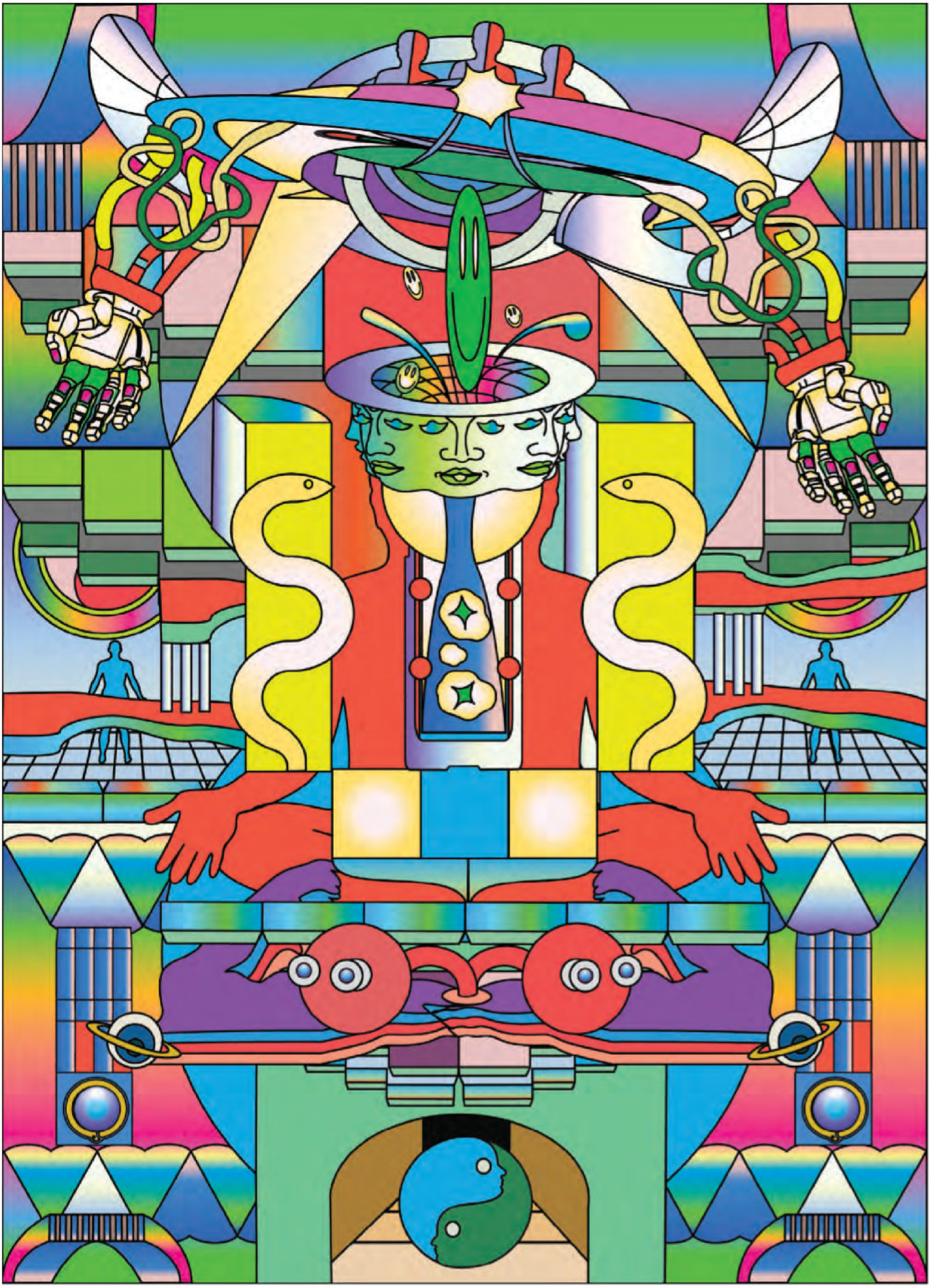

The New Space Race: The Moon, Mars & Beyond_

by Tomas Weber_

4 The Hibernator's Guide to the Galaxy by Brendan I. Koerner_

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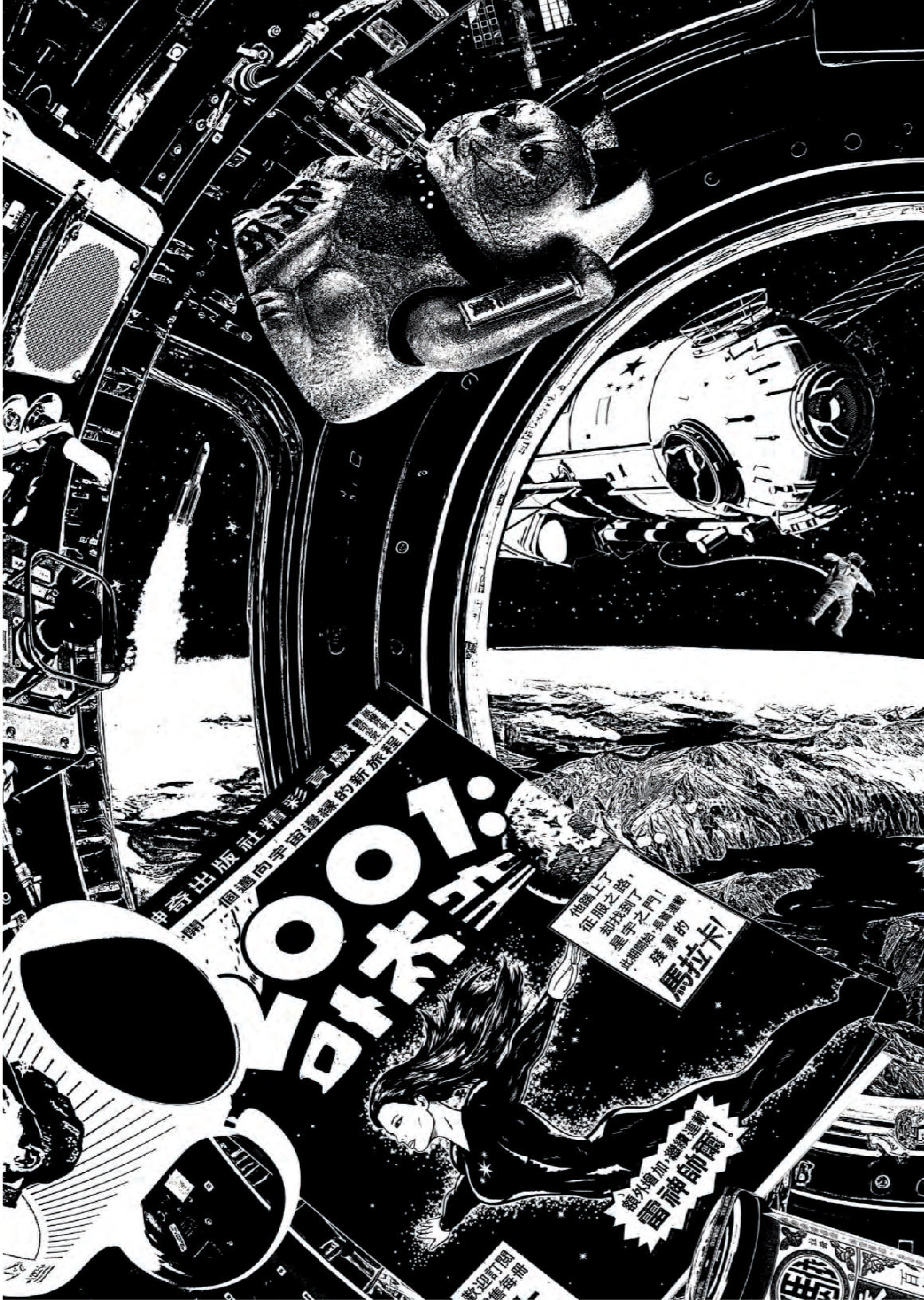
1 **China's Giant Leap** by Tim Marshall_

2 **The European Satellite Giant Taking on Elon Musk** by Morgan Meaker_

3 **Permission to Launch**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CHINA'S GIANT LEAP

Moon bases. Satellite-killing weapons. Asteroid mining. The battle for space could define the 21st century—and the People's Republic is rocketing ahead. By Tim Marshall

Illustrations by Gregori Saavedra

IT'S 2061. Earth's surface is frozen solid. To escape an expanding Sun, the planet has gone walkabout. Thousands of fusion engines propel it across our solar system. The further from the Sun it travels, the colder it gets. Half the population is dead, and survivors live in vast underground cities. But Earth must reach Alpha Centauri, where there is a perfectly good, non-expanding Sun to allow us to get back to normal. "A journey of 4.5 light years begins with a single step", as Confucius never said.

That's the plot of the thoroughly bonkers and entirely enjoyable 2019 Chinese sci-fi movie *The Wandering Earth*. On release, it broke domestic box-office records and globally it has become the fifth-highest-grossing non-English-language film of all time. It is interesting on a number of levels, not least for what it says about soft power and how China projects its view of space.

The film's director, Frant Gwo, says American science-fiction portrays space as "the endless frontier"—a new horizon for humans to colonize. By contrast, the Chinese narrative, he argues, is to improve life on Earth by using space as a resource. "When the Earth experiences this kind of crisis in Hollywood films, the hero always ventures out into space to find a new home, which is a very American approach—adventure, individualism," Gwo told *The Hollywood Reporter*. "But in my film, we work as a team to take the whole Earth with us. This comes from Chinese cultural values—homeland, history and continuity."

It's no surprise that *The Wandering Earth* has been enthusiastically embraced by the Chinese Communist Party—It was partially produced by the state-owned China Film Group Corporation and The Ministry of Education recommended that it be aired in schools across the country. It aired globally on Netflix, and the Foreign Ministry in Beijing did its bit for publicity, with spokeswoman Hua Chunying telling journalists unprompted: "I know the hottest movie now is *The Wandering Earth*. I don't know if you have watched or not. I'd recommend it."

The Wandering Earth chimes nicely with Xi Jingping's political agenda. Beijing knows that its growing space capabilities are viewed as a threat by the USA and other countries. Using soft power, such as cinema, allows it to suggest to foreign audiences that there is nothing to fear from its activities, while simultaneously boosting domestic national pride and interest.

The Chinese president has long pushed the idea that China's space program—which is entirely and directly controlled by the People's Liberation Army—is no threat to anyone; indeed that it seeks to work within international frameworks and for the good of humankind. But is that really true? And how will China's stellar ambitions shape the future of global politics?

CHINA'S LEADERS see space as being integral to their future plans. President Xi Jinping believes that China should have more of a leadership role in the world, and it takes a "techno-nationalist" approach to modernization, understanding that it needs to be a technological leader if it is to achieve its aims.

Chairman Mao took a similar view to Xi, and in the late 1950s the decision was made to invest in long-range missiles and space technology, despite China still being a poor and primarily agricultural country. Where America had Wernher von Braun and Russia had Sergei Korolev, the "father of Chinese rocketry" was Qian Xuesen, who spent decades in the United States at MIT and Caltech, where he was part of a team nicknamed "The Suicide Squad" due to their explosive attempts to build a rocket on campus.

During the Second World War Qian worked on America's response to Germany's V-1 and V-2 rockets, and by the war's end he was considered one of the world's foremost experts on jet propulsion. He even worked alongside von Braun on the Manhattan Project to develop the first atomic bomb. But that all counted for nothing. In 1949, as the Communist party was seizing control of China, the Americans accused Qian of being a communist sympathizer. He was stripped of his security clearance and put under house arrest. When he was finally allowed to leave the United States in 1955, he departed for China, telling reporters he would never set foot in the USA again. He kept his word. America's loss—and China's gain.

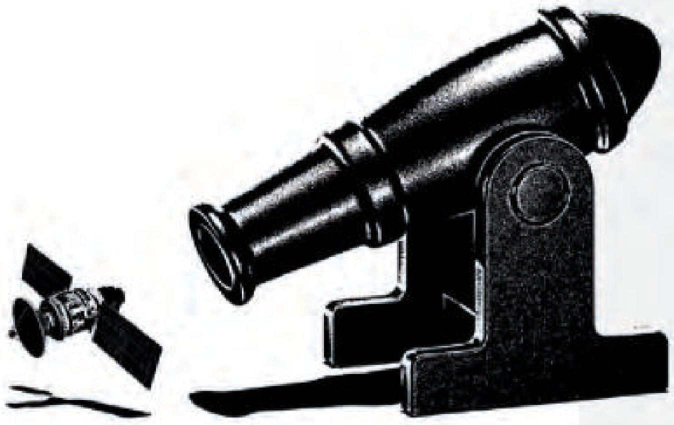
LOFTIER GOALS INCLUDE LANDING CRAFT ON PASSING ASTEROIDS TO MINE THEM FOR THE RICHES THEREIN.

中国航天
USA

While the communists were solidifying their control of China in the mid twentieth century, the Americans and Soviets were spending billions in the Space Race. The bragging rights of who reached each milestone first were of less concern to the Chinese than the technological advances. The bigger and more far-reaching the rockets, the more alarmed Beijing became that they could be militarized and used against China. So Qian was set to work training a generation of scientists who helped develop China's nuclear bomb and the country's Dongfeng ballistic missile system.

In 1956, in the spirit of "brotherly assistance", the Soviets provided Qian with the blueprints for their R-1 rockets and sent specialists to Beijing to jump-start the Chinese ballistic program. A testing site was built in the Gobi Desert and dozens of Chinese students were sent to Moscow for training. The Chinese wanted access to more modern rockets, but the Russians were reluctant to allow their very latest technology to be transferred to another country. The Chinese students resorted to copying restricted documents and tapping their instructors for knowledge.

By 1960, relations between China and Russia had deteriorated and cooperation was withdrawn. But Qian was able to use this rapid absorption of technical knowledge to oversee the launch of China's first satellite, and laid the foundations for the Chinese space program, as well as its ballistic missile technology. His story is a warning about rejecting outside scientific knowledge based on flimsy suspicions of intent. Former US Navy Secretary Dan Kimball said America's treatment of Qian was "the stupidest thing this country ever did".



In 1967, Mao gave the order to put a taikonaut into space, and the first candidates were chosen for training. But the program was canceled when the country was engulfed in the chaos of the Cultural Revolution, during which many scientists were imprisoned or killed. Zhao Jiuzhang, the head of China's satellite program, was denounced as a "counter-revolutionary" and beaten up by the Red Guards. He is thought to have drowned himself in Beijing's Lake of Great Peace.

Despite these setbacks, in April 1970, China became the fifth country to put a satellite into Earth orbit (after the Soviet Union, the USA, France and Japan). By the mid-1980s China was launching satellites on a regular basis and offering its facilities to other countries. In 2003, China became the third country to send a human into space in what The China Daily newspaper called "The Great Leap Skyward".

Then, in 2007, China deliberately destroyed one of its own weather satellites in a test of a spacebound missile known as a kinetic kill vehicle (KKV). Other countries were horrified about the profusion of space debris, but impressed—and alarmed—that the Chinese had pulled off the equivalent of hitting a bullet with a bullet: traveling at about 29,000 km/h, with just a second to go before impact, the KKV made three lightning-quick adjustments to its trajectory to hit the 2-meter long satellite square on.

Although Chinese officials denied the test was part of a space arms race, there have been allegations that Beijing is powering ahead with research on ground-based directed-energy weapons designed to strike enemy targets in space, and reports of domed buildings with retractable roofs in remote parts of China that could be deployed for targeting satellites from the ground.

For the first few decades, China's space program was primarily about achieving military ambitions, in addition to using satellites for monitoring the weather and—as the country began to industrialize—deciding where to put roads and railways. In this century, though, the Communist Party has started to use space as a way to signal China's status as a military, technological and economic leader.

IN EARLY 2022, Beijing published a "Perspective" on its space program, beginning with a quote from President Xi Jinping: "To explore the vast cosmos, develop the space industry and build China into a space power is our eternal dream." There are plans for next-generation manned spacecraft, a human lunar landing, an international research station on the Moon, probing asteroids and deep space exploration.

China's Mission Vision is to "freely access, and efficiently use, and effectively manage space". The "freely access" and "effectively manage" parts are a shot across the bow of the Americans and any attempt to deny China its place in the heavens. In 2019 the head of its Lunar Exploration Program, Ye Peijian, said: "If we don't go there now, even though we are capable of doing so, then we will be blamed by our descendants. If others go there, then they will take over, and you won't be able to go even if you want to. This is reason enough."

The document is explicit in its call for the United Nations to have the central

***Below*: China's ambitions include a permanent Moon base by 2028.**

role "in managing outer space affairs". It points out that since 2016 China has signed space agreements or memoranda of understanding with nineteen countries and regions and four international organizations, including Pakistan, Saudi Arabia, Argentina, South Africa and Thailand. It emphasizes cooperation with the European Space Agency, Sweden, Germany and the Netherlands. It trumpets that it has provided satellite launches for a range of countries and opened its facilities to developing states such as Laos and Myanmar.

This is all pushback against what Beijing sees as the USA trying to dominate governance of space. Over the years, there have been efforts to collaborate with America. In early 1984 President Reagan offered a place on the US Space Shuttle to a taikonaut. In 1986 a group of Chinese scientists were due to visit Houston's Manned Spacecraft Center as part of the preparations, but the visit was canceled after the Challenger space shuttle exploded.

In 2011, the United States Congress passed the Wolf Amendment, which limits NASA's ability to cooperate with Chinese organizations and scientists. As a result, China has been frozen out of the Artemis Accords, a non-binding treaty that seeks to govern peaceful space exploration. The rationale of Republican Congressman Frank Wolf was that the relationship between space exploration, technological advances and China's military was such that the USA could not risk collaboration with its growing rival. Specifically, the concern was about the possibility of intellectual property theft from NASA computers and joint US-Chinese research, which Beijing was applying to sensitive military technologies including ballistic missiles.

Chinese hackers are known to have briefly gained entry to computer systems at the Department of Defense, the office of the Secretary of Defense, the US Naval War College, the Pentagon, a nuclear weapons laboratory, and the White House. More traditional espionage activity has also been uncovered. In 2008, Shu Quan-sheng, an American physicist living in Virginia, was convicted of transferring information about the liquid hydrogen tanks of a US rocket to Beijing. In 2010, Dongfan Chung, a former engineer at Boeing, was convicted of providing China with more than 300,000 pages of sensitive information, including data about the US Space Shuttle.

China has reacted to being frozen out by constructing a rival to the International Space Station, forming strategic scientific relationships with a host of countries, and building a domestic space industry which looks at least as cutting-edge as that of the USA, all without input or monitoring from the Americans. In 2014, China completed its new, coastal spaceport at Wenchang, specifi-

CHINA IS CURRENTLY THE ONLY COUNTRY OPERATING ITS OWN SOVEREIGN SPACE STATION. IT'S NO MOON BASE, BUT IN ASTRO-POLITICAL TERMS, IT'S STILL QUITE A STATEMENT.

cally for the larger diameter Changzheng rockets, which need to be launched over water. In 2016, two taikonauts spent a month on board the Tiangong 2 space station after their craft successfully docked with it. In 2019, China broke new ground when the uncrewed Chang'e 4 became the first spacecraft to land on the far side of the Moon, and in 2020 the final BeiDou satellite was put into position, completing a navigation network to challenge the American-owned Global Positioning System (GPS).

But perhaps the biggest milestone in the last decade was orbiting, landing and then deploying a rover on Mars. The Tianwen-1 mission arrived at the planet in February 2021 and spent three months searching for the right location to touch down. On May 14, the lander left the orbiting vehicle and made a soft landing. The Zhurong (God of Fire) rover was then released to conduct surveys of Martian geology, search for water, and beam back sound and vision.

All of this is a source of great pride in China and is interwoven with the mythology of the Communist Party. China's Changzheng (Long March) rockets are named after a famous military retreat during the Chinese civil war in 1934–5, in which the Red Army covered 9,000 kilometers over rugged terrain. It helped Mao come to power and go on to defeat the anti-communist forces. It is part of the foundation myths of the Chinese Communist Party and is often used as an example of heroic sacrifice to achieve greatness. To use the term for the rockets propelling China to greatness in space is deeply symbolic.

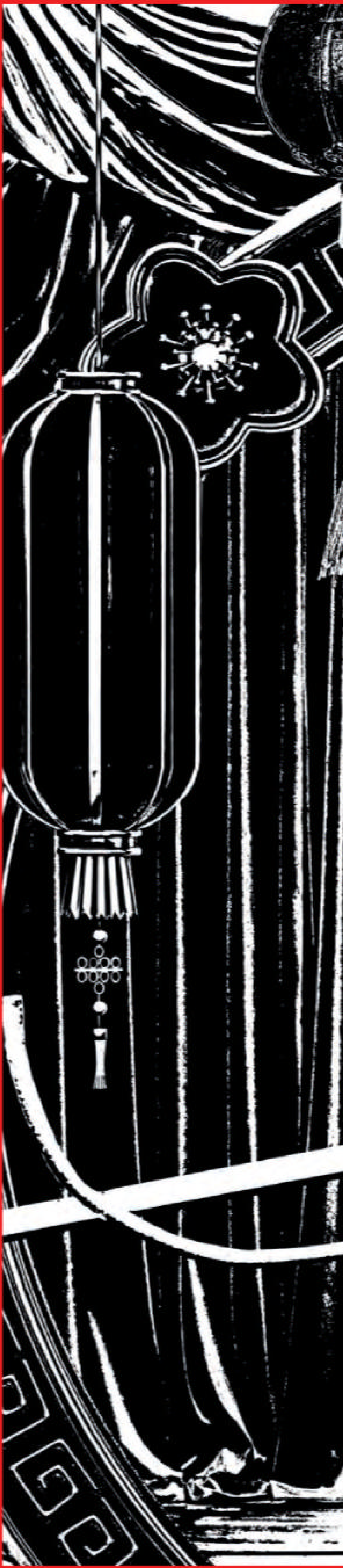
In recent years, China has softened some of its public exhortations about the superiority of communism and instead has embraced elements of nationalism and myth from an older historical collective memory. This is reflected in the naming of space missions and equipment. The uncrewed craft that orbited the Moon in 2007 was called the Chang'e 1 after a beautiful fairy who, in Chinese folklore, stole the elixir of immortality from her husband, drank it, flew to the Moon and became a celestial goddess. Meanwhile, on board Space Station Tiangong, taikonauts, who travel to it in a Shenzhou ("Divine Vessel") capsule, can thank their lucky stars they are in the "Heavenly Palace" named after the residence of the Celestial Ruler who holds supreme authority over the universe in Chinese mythology.

The word "taikonaut" is a mixture of Mandarin and Greek, from taikong, meaning "cosmos", and naut, Greek for "sailor". These names are important. They signal to the world that space is not just the domain of Americans and Europeans, and that for every Artemis there is a Chang'e.

IN 1995, a Chinese rocket exploded after take-off and killed at least six people on the ground. The exact details of what happened are still unknown—a reminder that China remains in many ways a closed society. Despite that legacy of secrecy, however, it's now common knowledge that its launch capacities are expanding.

The Chinese National Space Administration (CSNA) now has several launch sites across the country, from the Taiyuan facility in the Gobi Desert, which launches some of China's weather satellites but is also part of its intercontinental ballistic missile system, to the Xichang Satellite Launch Center in Sichuan province and the more modern Wenchang Space Launch Site on the South China Sea island of Hainan which is used to get taikonauts to the Chinese space station and for longer uncrewed missions.

A new launch facility is being completed in the eastern port city of Ningbo, about two and a half hours' drive from Shanghai. Within a few years it is expected to be launching 100 commercial rockets a year in what are called "quick-fire" lift-offs. Like the Kennedy



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CHINA SEES SPACE AS BEING INTEGRAL TO ITS FUTURE PLANS, AND ITS LEADERS ARE TAKING A 'TECHNO-NATIONALIST' APPROACH TO MODERNIZATION.

Space Center in Cape Canaveral, Ningbo is on the coast, meaning rockets do not have to fly over land, and has a favorable latitude for breaking out of the atmosphere quickly.

Local officials want Ningbo to be known as "China's Space City". It's only a few miles from a cluster of commercial launch industries near the mouth of the Yangtze River, with access to a huge port and other space-focused industries in Shanghai. The country's largest car manufacturer, Geely, has its headquarters there and is investing heavily in satellite design and aerospace-related industries. In 2022 it used the Xichang facility to launch nine of its own satellites into low Earth orbit as the first stage of a network to provide more accurate navigation for autonomous vehicles.

This is all part of the growing commercial space industry in China. It remains behind the USA in terms of private funding, but companies are keen to invest, especially in launching satellites before low Earth orbit gets too crowded. The CCP began to encourage private investment in 2014; however, as with all Chinese enterprises, the link with the state is stronger than in most countries. There are now more than 100 private space-related companies in China, but many are spin-offs from the government sector. For example, the rocket manufacturer ExPace, based in Wuhan's Space Industry complex, is a subsidiary of the state-owned China Aerospace Science and Industry Corporation.

Others have more distance from the state: i-Space, for example, was the first private Chinese company to achieve orbit when it launched its Hyperbola-1 rocket in 2019. However, this was followed by two failures in 2021. Others have also experienced serious setbacks. To help counter this, the government is slowly allowing the transfer of previously restricted state technology and expertise into the sector as part of a national strategy of civil-military fusion. This links the state, private enterprise and the country's top research universities in clusters of technological excellence in a more formal manner than in the USA. In a very competitive market, some of the new companies are bound to fail, but what is equally sure is that some will rise to become powerful national and, probably, global players. In all this China will be helped by a huge, dynamic workforce. Long-term demographic problems loom, but for now it can still turn out huge numbers of scientists and engineers—the Beijing Aeronautical Institute alone has 23,000 students. Each year this century China has increased the number of engineers who graduate, while in the USA there has been a year-on-year decrease.

In the near future, Beijing intends to further develop its BeiDou Navigation Satellite System, having seen the $1.4 trillion boost GPS has given to the US economy since the mid 1980s: American farmers use it to plan the best use of their land, delivery services are steered more efficiently thorough cities, financial institutions can timestamp transactions, and ship owners can track their fleets. BeiDou's encrypted military application is more accurate than the civilian version and will be used to monitor the movements of the PLA and the armed forces of other countries.

China also intends to launch at least 1,000 satellites over the next decade. It will increasingly offer its services to developing countries that cannot afford to launch rockets or have satellites of their own. This will be used to cement bilateral ties in an attempt to pull states away from the USA. Satellites used for scientific discoveries are likely to have some notable triumphs to rival that of the Hard X-ray Modulation Telescope, China's first X-ray astronomy satellite, which observes black holes and has discovered the strongest magnetic field in the universe.

Loftier goals include landing on passing asteroids to mine them for the riches therein. Some of these rocks are tens of kilometers wide and contain billions of dollars' worth of the metals required for twenty-first-century technology. One of China's many startup companies, Origin Space, has already launched a robot prototype to capture and destroy space debris, and intends to develop it to be able to mine asteroids.

There's also the intention to send another probe to Mars. Just getting there is hard enough, but China, along with the USA and the European Space Agency, is working on plans to dig up some soil and rock samples and then get them back to Earth. Further out, they want to send probes to Jupiter and Saturn. But perhaps the project with the greatest political significance is China's coming Moon landings. In 2021 China and Russia signed a memorandum of understanding that they will jointly build a base on the Moon called the International Lunar Research Station (ILRS). They envisage three phases: first, reconnaissance up to 2026, including three crewed missions; then landing on the Moon, followed by "returning". The south pole has been earmarked because its icy craters are a potential source of water.

When China landed a non-crewed craft on the far side of the Moon in 2019, it planted the Chinese flag on the surface and began digging for rocks in a region it is considering using as a base. Some reports suggest China wants a permanent presence on the Moon as early as 2028, but this seems beyond ambitious; 2030 is more realistic, and even that would be impressive.

The first structure built will enable mining, to extract the resources that will allow the base to grow—central to this is water, hence the south pole. Moscow and Beijing say they intend the base to be fully open by 2035; the American-led Artemis project is more vague about its timetable. Building a base on the Moon will capture a generation's imagination in the way the 1969 Moon landings did. Flowing from that will be an appreciation of the technological brilliance and, equally importantly, resolve, of the nation or nations who do it first. This is not just about "planting a flag": it's about seizing the "High Frontier" for both military and commercial advantage. The prizes are the Moon's potential riches, and the ability to use it as a gravitational point to deploy military satellites that would be difficult for competitors to detect.

FURTHER CLAIMS on the "geography" of space will be made as the decade progresses. China is already the only country operating its own space station, the Tiangong 3. It doesn't make headlines in the way a Moon base will,

> **CHINA AND THE USA LOOK DESTINED TO SPEND THE NEXT DECADE MOSTLY ISOLATED FROM EACH OTHER WITH REGARD TO SCIENCE.**

but in astro-political terms, having the only sovereign station is quite a statement—the better-known ISS is a "cooperative program" involving European countries, Japan, Russia, the USA and Canada.

The Tiangong is owned and operated solely by China and is expected to be in service up to about 2037. Versions 1 and 2, built between 2011 and 2016, were test versions for the third, which is almost three times heavier and much bigger—although it only has three modules, whereas the ISS has sixteen. On board, taikonauts are researching space medicine, biotechnology, microgravity combustion, fluid physics, 3D printing, robotics, directed energy beams and artificial intelligence.

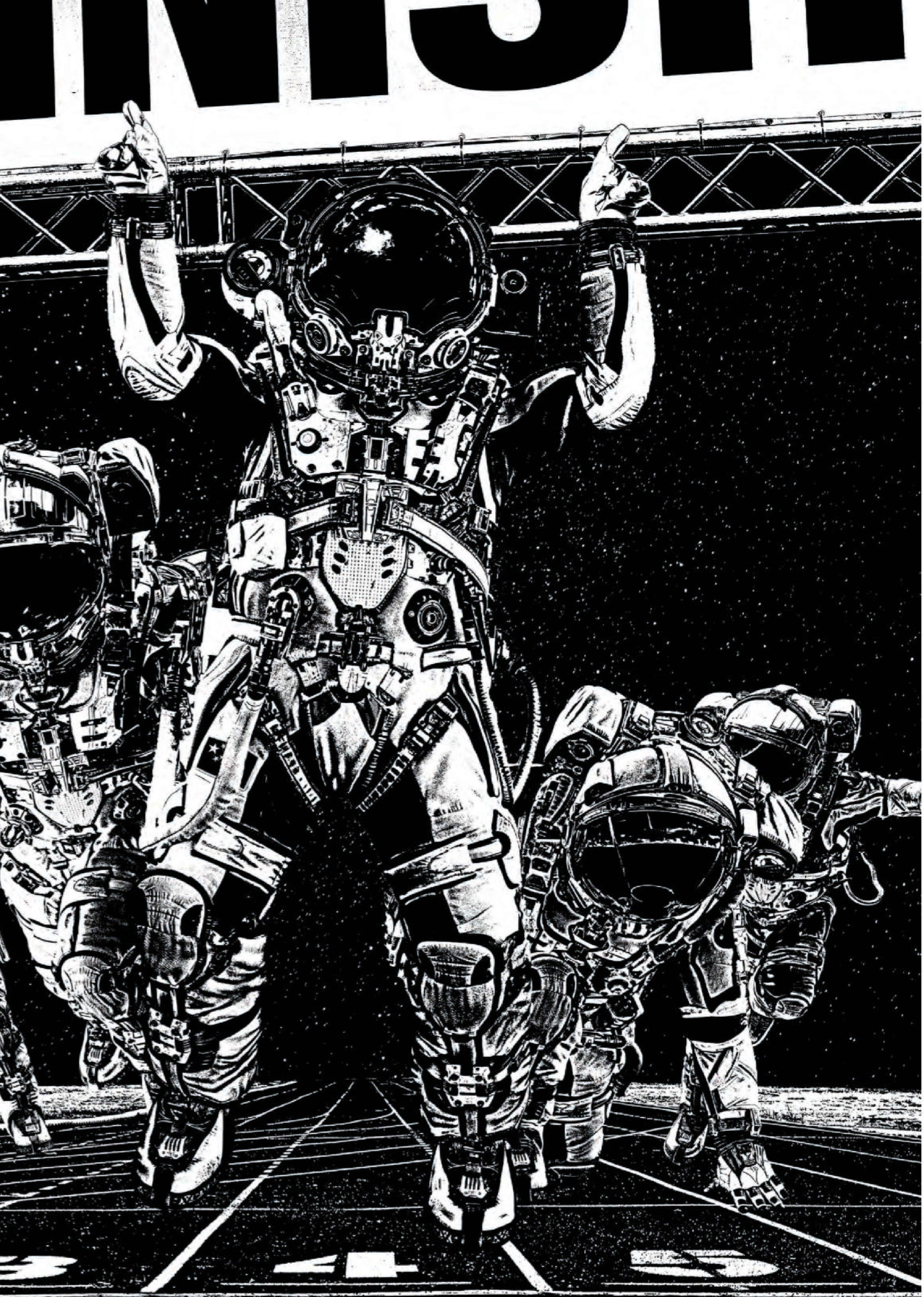
As the ISS approaches decommissioning, by 2030 at the latest, a small window may open for China. The Artemis program includes the Lunar Gateway—a small station orbiting the Moon acting as a hub to allow spaceships, crews, landing modules and rovers to resupply during frequent trips. But any serious delays in building the Gateway will leave the Tiangong as the only place open for guests, and that will be a demonstration of Chinese hospitality, spirit of cooperation and ... leadership. Beijing has already said it hopes to host visits by international astronauts and wants to work "with all countries in the world committed to the peaceful use of outer space".

China and the USA look destined to spend the next decade mostly isolated from each other with regard to high-tech science and engineering, two areas that are crucial in addressing the challenges humanity faces both on Earth and in that most hostile of environments for humans, space. Cooperation is possible. Replacing the Wolf Amendment with something less like a sledgehammer would help, and even as that is worked on, because the amendment is specific to NASA, the US Departments of Defense and State have room to explore bilateral avenues of mutual benefit.

Détente between the Americans and Soviets was helped by the Soyuz/Apollo "handshake in space". Following the end of the Cold War, collaboration between Russia and the USA on the ISS was a bridge on which at least to try and build a better relationship. The return to the Moon offers a similar opportunity for the USA and China. But whether either side is able or willing to make that leap in space might depend on their relationship on Earth.

TIM MARSHALL *is the author of* The Future of Geography: How Power and Politics in Space Will Change Our World *(Out April 27, £20, Elliott & Thompson).*

Right: **The nation that wins the new Space Race will set the agenda.**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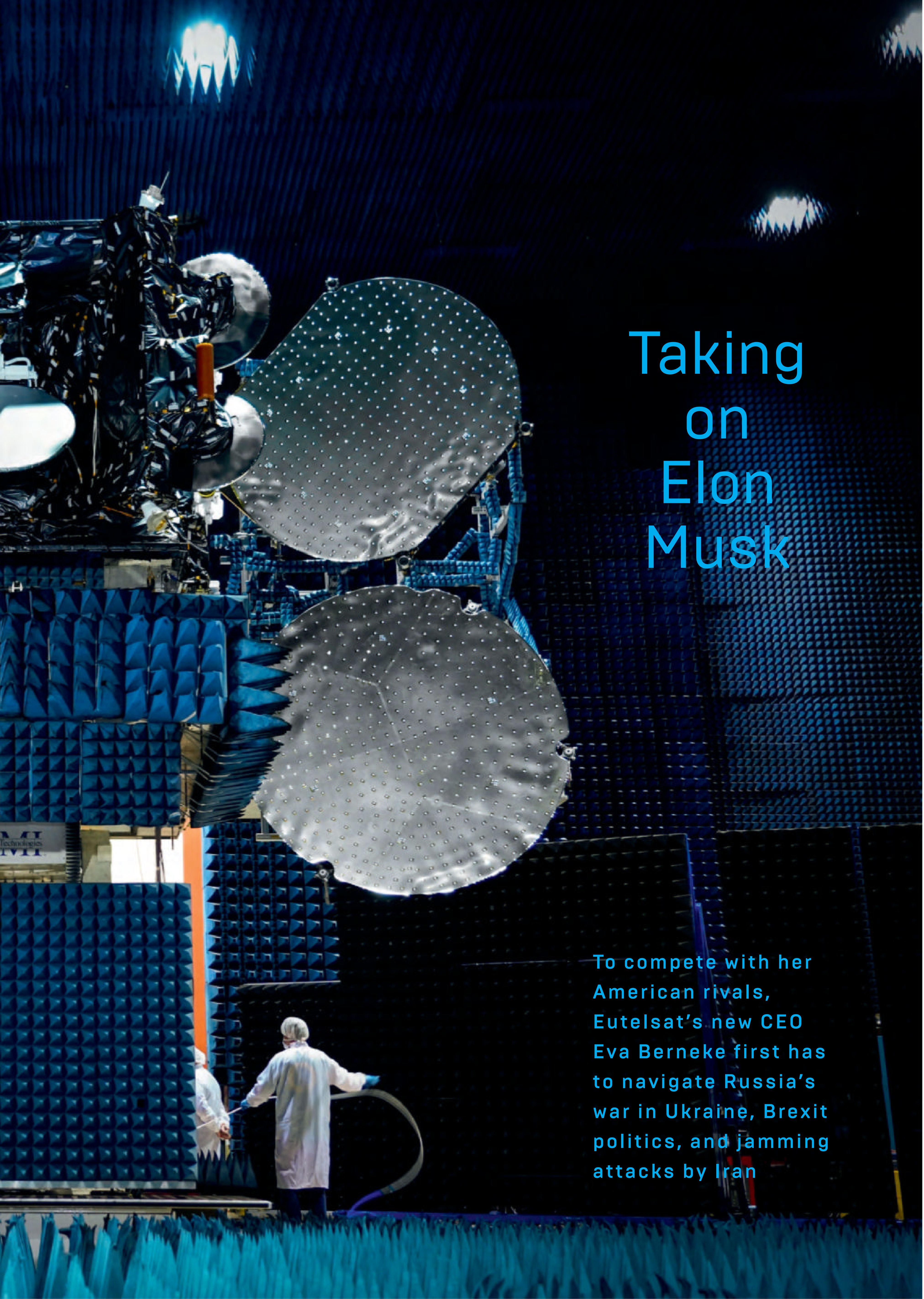
The European Satellite Giant

STORY BY
MORGAN MEAKER

PORTRAIT BY
LAURA STEVENS



Taking on Elon Musk

To compete with her American rivals, Eutelsat's new CEO Eva Berneke first has to navigate Russia's war in Ukraine, Brexit politics, and jamming attacks by Iran

***Previous*: The EUTELSAT 7C undergoes antenna testing in Maxar's facility in Palo Alto.**

EVA BERNEKE DESCRIBES her first year at the helm of the world's third largest satellite company as a "whirlwind". That's an understatement. Since she took over the top job at Eutelsat in January 2022, the Danish chief executive has become a direct competitor to Elon Musk, been accused of aiding Russian propaganda by the Ukrainian government, and found herself in the thick of bitter Brexit politics—and that's before you even mention the Iranian sabotage attempt.

Despite all that, Berneke gives the impression that she has everything under control. When she arrived at Eutelsat, the French company's bread-and-butter business was beaming TV channels into homes using geostationary satellites—which move at the same speed as Earth and so stay in a fixed position. The organization she inherited was stable and solid, she says—but also stagnating in an industry that was experiencing radical change. Although Eutelsat was starting to use its geostationary fleet to offer satellite internet, its TV revenues were eroding.

The entrance of two of the world's richest men into the industry—Elon Musk with SpaceX's Starlink, and Jeff Bezos' Project Kuiper—was also beginning to change the way incumbents thought about their future. "When you have two of the biggest business innovators interested in your industry, you should expect a little bit of shaking up," says Berneke.

Berneke responded by initiating her own shake-up. In July, Eutelsat announced plans to merge with struggling British satellite company OneWeb. As part of the deal, Eutelsat absorbed OneWeb's constellation of 648 low orbit satellites. At just 1,200 km above Earth, the OneWeb fleet delivers faster internet speeds than Eutelsat's geostationary satellites, which sit at 35,000 km high.

"WHEN TWO OF THE BIGGEST INNOVATORS ARE INTERESTED IN YOUR INDUSTRY, YOU EXPECT A BIT OF SHAKING UP."

OneWeb is Eutelsat's ticket into the booming low orbit satellite market. Rural homes, ships, airlines, militaries, and autonomous vehicles are looking to satellite internet to stay connected in places previously considered dead zones. "Even in France, a country with very high fiber and 5G coverage, it's estimated that around 4 per cent of households are without good connectivity," says Berneke. She expects this figure to rise to 15 per cent of households in countries with less fiber and 5G. "So it's not that small a niche."

The OneWeb-Eutelsat merger has been touted as Europe's entry into the space race. It is the only company currently competing with Musk's Starlink in low-orbit. But to claim the title of a European space giant, Eutelsat first has to navigate messy post-Brexit politics. Both France's Eutelsat and Britain's OneWeb were part owned by their respective governments and the two countries will continue to own stakes in the new business.

Berneke admits Brexit is not making running the company easy. "But there's been a willingness on both sides to reach across The [English] Channel to find a good way of collaborating," she says. If Europe wants a homegrown satellite giant, Britain and France will have to resolve their differences. "[OneWeb's fleet] is going to be one of the only non US-based constellations for a while," she says.

Brexit politics is not the only challenge. OneWeb's Gen One satellites need upgrading and Eutelsat is planning to have more-advanced Gen Two satellites in orbit by 2027. Berneke says this upgrade will cost between three and four billion euros, an amount that marks a dramatic change for a company with a reputation for playing it safe. Analysts at J.P. Morgan have described the merger as "high risk". But Berneke says this new approach to running the company is a conscious decision—partly influenced by Musk. "Starlink has really, truly innovated, making [satellite] launches much more industrial," she says. "I think that's something we all should be looking at and saying, how can we move forward much, much faster? It's also being open to risk."

SpaceX's attitude to risk was demonstrated by its close collaboration with the Ukrainian government, which exposed Starlink satellites to Russian jamming attacks. Eutelsat, however, was pulled into the war for a different reason. In November, Ukraine's culture minister, Oleksandr Tkachenko, published an article in French newspaper *Le Monde*, criticizing Eutelsat for continuing to broadcast TV channels that carried Russian propaganda. Berneke did not deny the claims. "We've always had what we call a policy of neutrality," she says. Eutelsat follows guidance issued by French media regulator ARCOM on which channels are and aren't sanctioned.

Berneke resists the idea that executives should implement their own sanctions, on top of legally binding restrictions—a trend that has been gathering pace since Russia's invasion of its neighbor. Apple, for example, voluntarily halted product sales in Russia after coming under pressure from the Ukrainian government. "We're not going to try to do more ourselves," she says. Instead she argues this stance gives the company more legitimacy to push back when regimes, like Iran, do not want some western channels broadcast locally.

In October 2022, the company accused Iran's regime of jamming its satellites. "We did all kinds of technical hoops and loops to make sure that we continued broadcasting, because we had paying customers and we thought it was important that channels were not sanctioned," she says. "So it goes both ways."

Morgan Meaker (@MORGANMEAKER) is WIRED*'s senior European business writer.*

Below: Eva Berneke, chief executive of satellite firm Eutelsat.

***Below*: The successful launch of the EUTELSAT 8 West B by Arianespace from Kourou, French Guiana.**

Above: A dish at the Eutelsat Paris-Rambouillet Téléport, which can send and receive signals from its satellites, including video broadcast, content distribution, and data. Eutelsat owns six stations, and works with more than 60 partner téléports to enable access to its satellites from almost any location.

Right: The EUTELSAT KONNECT VHTS (Very High Throughput Satellite) enters the thermal vacuum chamber at Thales Alenia Space for pre-launch testing. The KONNECT has the most powerful digital processor currently in orbit, and uses the 500 Gbps-capacity ka-band frequency. Launched in November 2022, it will support European fixed broadband and in-flight connectivity businesses.

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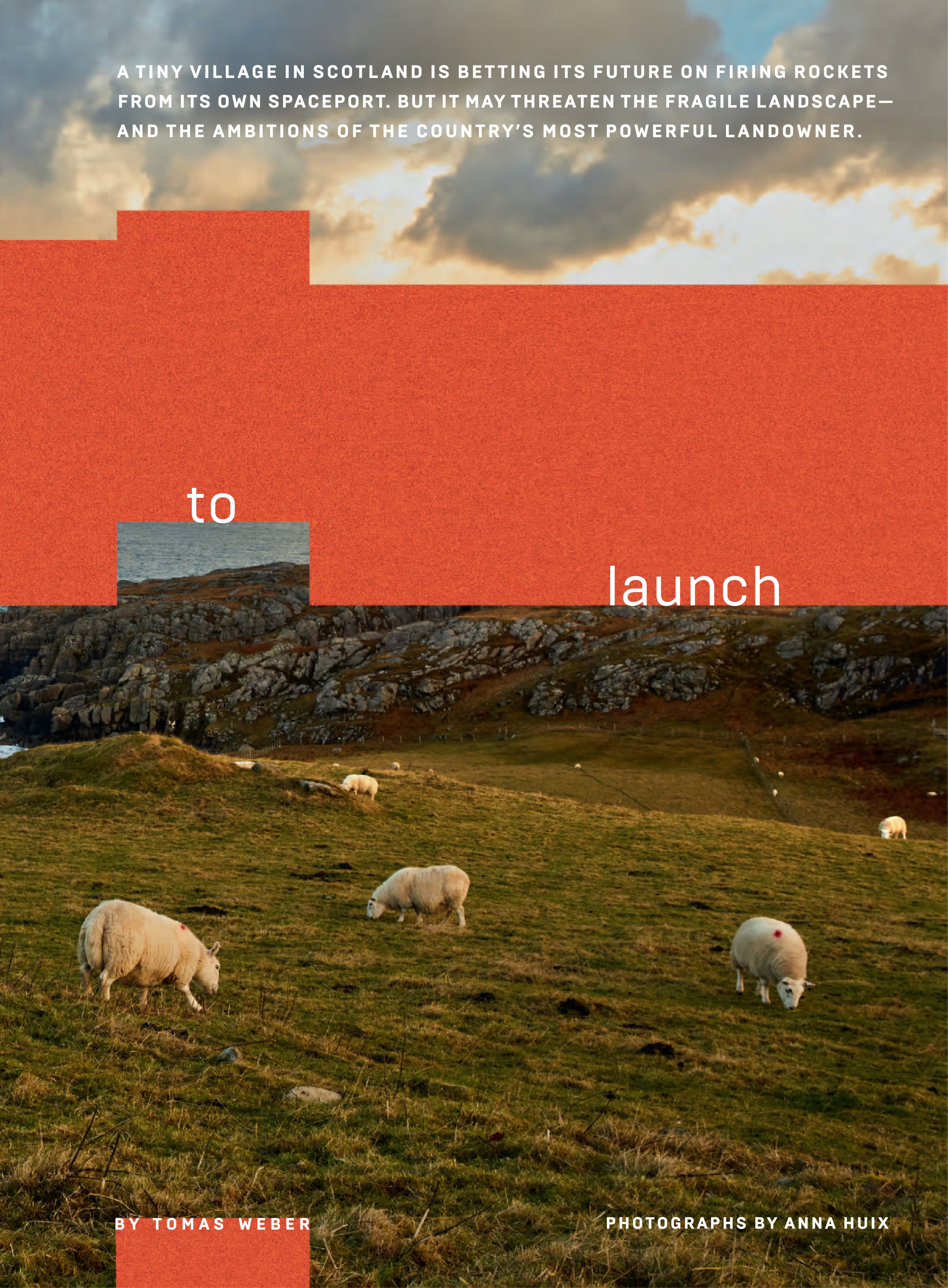


A TINY VILLAGE IN SCOTLAND IS BETTING ITS FUTURE ON FIRING ROCKETS FROM ITS OWN SPACEPORT. BUT IT MAY THREATEN THE FRAGILE LANDSCAPE—AND THE AMBITIONS OF THE COUNTRY'S MOST POWERFUL LANDOWNER.

to launch

BY TOMAS WEBER

PHOTOGRAPHS BY ANNA HUIX

IN THE VILLAGE of Melness, a frayed twist of bungalows and old stone buildings on Scotland's desolate northern shore, April is a month of new beginnings, when the dark and strung-out Highland winter finally unfurls into a tentative spring, and pregnant ewes balloon like airships in the windswept hills. As the 2015 lambing season neared its start, the villagers began the usual preparation of their small plots of rented land, called crofts, for farm and pasture. Behind the crofts and croft houses was the bog: an immense, bronze-hued ocean of deep peat, stretching into the horizon.

For Dorothy Pritchard, a retired schoolteacher and chair of the Melness Crofters' Estate, an organization that owns and manages the crofting land, this spring would be stranger than usual. Over the past several weeks, she had been mulling a plan that could upend the town's quiet routine.

On the last day of the month, she walked into the estate office, a dirty, white bungalow opposite the village nursing home, for a meeting with the estate board. Many of the members were from families that had been working the land for generations, and Pritchard sought to preserve their way of life. As the crofters took their seats on plastic chairs around the table, Pritchard announced that she had an idea. It might sound crazy at first, she cautioned, but give it an open mind: How about building a spaceport on the empty peatland out back?

The estate office rang out in guffaws.

Rockets lifting off in nebulas of smoke from the bog, inclining to their flight path over Tommy’s shop in Talmine, cracking the sound barrier over the summer wildflowers on Achininver Beach? It was hard to imagine. And there were concerns. Melness, made of nothing but mountains and peat and sea and weather, was a tranquil place. Would rockets not ruin it? Would they have to fence off the common grazing land? Would they have to leave their homes on launch days? Would it be safe?

Pritchard told them she’d initially shared their fears. When she first envisioned rockets taking off, she pictured a boggier, less clement Cape Canaveral: explosions, showers of fiery debris. Behind the Melness houses, on the far side of a grassy ridge, unrolled a section of peat bog called the Moine. Although the land might not have looked like much to outsiders, it was part of a massive, irreplaceable sink of carbon that had accumulated over millennia, holding almost as much carbon dioxide as the UK emits in a year—and areas of it are highly combustible.

Pritchard was reassured, though, by the fact that the project had government support. It had come to her through the local development board, in conjunction with a UK effort to elbow its way into the global space industry. Building a commercial spaceport in Melness—one of three proposed vertical launch sites in rural Scotland where there is good access to polar orbits—could help the UK become the first country in Europe to launch a small satellite.

Pritchard’s own hopes for the spaceport were humbler but no less urgent. In it she saw a way to preserve Melness’ crumbling future. Her father had been a crofter who, like many in the village, worked at the nuclear power plant down the coast and built offshore oil rigs. She’d started lambing at 8 years old, and her childhood memories were crowded with weekend dances that once surged with dapper teens from Strathy to Durness. By 2015, though, the oil industry was declining, the nuclear plant had been deactivated, the dance halls were empty, and the school rolls were dwindling. The town was down to a single hotel, a single store, a single nursing home. Every year, Pritchard saw her former students reach their late teens and flee to the cities down south: Inverness, Aberdeen, even Edinburgh. Keeping youngsters on the good side of Ben Loyal and Ben Hope, the two peaks that overshadow Melness, had become her obsession.

Anders Holch Povlsen owns thousands of hectares of land near Melness, Scotland.

GETTY IMAGES

The village had already cycled through several failed economic projects, including a leisure center, a wind farm, a new pier, and a tropical shrimp farm. Worse, in the absence of a self-sustaining industry, it was being steadily transformed by an outsider—the Danish billionaire Anders Holch Povlsen, who owns the fast-fashion company Bestseller.

Povlsen is the richest man in Scotland and its largest private landowner. He has acquired thousands of hectares of land around Melness, citing a mission to rewild the landscape and repair the damage caused by overgrazing. But his ideas for developments—including a brewery, an events space, and luxury resorts for “forest bathing”—are targeted at ultra-wealthy ecotourists. In the eyes of many locals, his investments bring to the fore the ballooning cost of real estate in the area.

Pritchard asked the estate members to consider the spaceport. It offered Melness a new vision for the future, she told them. It could give them a decent rental income and reliable employment. It could mean a revival of this place after a deep winter. After some hesitation, the board agreed to explore the idea. Pritchard was hopeful. At the same time, she knew the spaceport might not be enough to save Melness. There was a chance that it would bring disaster.

ON A HIGH rock between Melness and its sister city Tongue stands the stout ruin of Castle Varrich. The castle is on the territory of Clan Mackay, a Highland clan with roots in the Middle Ages. The Gaelic origin of Mackay, the area’s most common family name by far, is Mac Aoidh: son of fire.

Pritchard is a Mackay on her mom’s side, and her worries about the depopulation of the Highlands reach back as far as her family’s history. Much of Scotland’s land is owned by wealthy individuals—a higher percentage than any other country in Europe. Starting in the late 18th century, landowners mercilessly drove Highlanders out of townships along the fertile inland valleys to make room for sheep, which turned a greater profit than farming. This campaign of occasionally violent dispossession is known as the Highland Clearances.

In Sutherland, the county that contains Melness, the Duke and Countess-Duchess, together with Patrick Sellar, the notorious "factor," or manager, of the Sutherland Estate, were particularly cruel in their administration of the evictions. The Clearances reached their crest here in 1819, a year known in Gaelic as *bliadhna na losgaidh*: the year of the burnings. The homes of the members of Clan Mackay, sons and daughters of fire, were scorched to the ground.

Pritchard's ancestors were forced onto barren crofts, in settlements on the edge of inhospitable coasts. "They belonged to the ground," Kirsteen Mackay, a Melness crofter, told me, "and people came in and took it away." Inland folk for centuries, they struggled to learn how to fish, and many left for North America. Meanwhile, boundless herds of sheep set to work constructing the barren landscape characteristic of the Highlands today. The ancient pine and birch forests were turned into seas of open heath.

After the price of wool cratered at the end of the 19th century, the Highlands' economy shifted to deer stalking, and red deer, equally rapacious, took over from sheep. Today, areas from which communities were cleared—some of which now belong to Povlsen—are designated "wild land" by the Scottish government.

Highland landlords still lease crofts to the descendants of cleared families. For those in Sutherland, the evictions are a persistent memory and haunt contemporary conflicts over land. Compared to much of the Highlands, though, the status of the land in and around Melness is unusual: 5,000 hectares belong to the crofters themselves.

This situation is due to Michael Foljambe, the eccentric English owner of an extensive tract that had included Melness. In 1995, Foljambe decided to give his land away. Two-thirds of his landscape of burns, lochs, beaches, and bog went to his London relatives. For the final third, though, Foljambe did something unprecedented. After long discussions with Pritchard's father, Frank Gordon, Foljambe decided that

Thomas MacDonell (below), Povlsen's director of conservation, sits in a horse tack room in Glenfeshie.

the land should be given to the people who had worked it since the Clearances. The children of the people in the cemetery by the sea.

The crofters were ecstatic. The land, they thought, had long belonged to them, at least in spirit—but now they would be protected from a landlord's whims and fancies. There was a catch, though. The crofters had to generate income and jobs, and build housing, but now without Foljambe's cash. From then on, finding income was always a struggle, while the region's population declined.

In 2012, Foljambe's relatives sold their portion of the land to Povlsen. Povlsen was fond of the Highlands, having visited from Denmark as a child. He'd already bought his first estate there years earlier, and with this purchase his total landholdings amounted to some 47,000 hectares. He had started a company called Wildland, with a mission to reseed the landscape and repair the damage caused by centuries of overgrazing.

In photographs, Povlsen looks impish—bald head, neatly trimmed beard, boyish face. He is not a popular figure around Melness. Povlsen owns several properties in nearby Tongue that he has kept empty for years, including what was once the town's only supermarket. He also bought the area's only gas station. Land prices have swelled, in part due to investments in carbon credits; Wildland has sold carbon credits by restoring peatlands in an estate further south. In 2020, the price of Scottish estates rose by 87 percent in a single year; in 2021, farmland prices increased by 31 percent. As a result, locals are being outpriced while the value of Povlsen's land increases, further limiting the financial resources of residents to take him on. When Ellen Henderson, who grew up on the coast near Tongue, tried to purchase the building that once housed Tongue's bank, she was outbid by Wildland. "He is a tsunami of money," she told me.

Povlsen has spoken about being a custodian of the landscape and about his deep love for the area. He claims to be repeopling as well as rewilding, generating work in hospitality and construction. His company hires local construction firms and employs 20 people in the Melness area, a figure that will grow as his new developments open. Many residents, though, would prefer to have a diverse economy. Some are furious, seeing Povlsen as the Highlands' latest arrogant landlord.

According to Pritchard, Povlsen treats the area as a tourist village. "He's not from here, and he doesn't understand the culture," she told me. On Facebook, she referred to Povlsen as "the return of the Duke of Sutherland" and complained that his company "has the cheek to constantly use the phrase 'our community.'" The name "Wildland" doesn't help: Some residents suspect he would prefer the area to be empty.

Once the spaceport idea was introduced, it did not take long for the community to see how it might solve their long-standing problems. The area might finally, they thought, blast out from the history of inequity that had sucked them in like a peat bog.

SPACEPORTS HAVE A HISTORY OF LEAVING LOCAL COMMUNITIES IN THE DUST.

Dorothy Pritchard (below) is backing a controversial project to build a spaceport on peatland near her Highland village.

By 2018, DEBATE over the spaceport had reached every person in town. The local development board, now partnered with aerospace startup Orbex, was holding regular drop-in sessions to calm jitters, and eventually, many residents came to hope that they would soon see a 62-foot-tall rocket with payloads of microsatellites thrusting over their homes, blasting toward polar orbit within spitting distance of the post office. Others were not so sure. In November, the crofters held a vote on whether to continue supporting the spaceport project. The result, in the end, was 27 votes for, 18 against. “We were for it,” said Pritchard, “but not at any cost.”

The arguments fractured the once cozy community. John Williams, a retiree to Melness from the south of England, set up an organization to protest the spaceport. In spite of his “incomer” status, he amassed some support in the village. “If you can imagine a rocket going wrong, you’ve got the equivalent of a 20-meter blowtorch,” he told me. That, on the peat bog, would be like setting a coal field on fire.

The environmental concerns are serious. The Moine is part of a much larger area known as the Flow Country: 200,000 hectares of delicate peat that has been hoarding carbon since the end of the Ice Age. Six months after the vote, a catastrophic wildfire burned 5,700 hectares of the Flow Country and doubled Scotland's carbon emissions for the year. If rocket fuel, or sparks, were to come into contact with peat, there is an increased risk of wildfires, Roxane Andersen, a peat scientist, told me. Pritchard's anxieties, however, had by this time been allayed. "I don't think there's been a more examined piece of ground," she said.

What about human safety? Gordon McEwan, whose home is near the proposed launch site, is anxious about falling rockets. In a meeting with Orbex and other crofters, he shared his concern that the launch exclusion zone was too small. When the rocket lifts off, the zone will have a radius of less than 2 kilometers. Orbex's response was to trust the regulators. "You can't randomly launch things of this nature," Chris Larmour, the CEO of Orbex, told me. "We are a heavily regulated industry." A Highland newspaper reported, though, that at a space industry event in 2021 he'd admitted he wouldn't want one in his backyard either.

According to Orbex and the development board, the economic benefits will outweigh these risks. They expect the spaceport to create around 40 jobs—from security and engineering to marketing roles—in an area with a population of several hundred. Some workers, they think, will commute from bigger towns on the North Coast, but others may settle in the Melness area, boosting the school rolls. A report commissioned by the development board predicted that during the first two years of its operation, the spaceport would add several million dollars worth of gross value to Melness and Tongue's economy, and attract thousands of visitors—a big boost for tourism.

Spaceports, though, are rarely a solution to the problems faced by marginalized areas, and they have a history of leaving local communities in the dust. They require sparsely populated land, usually near the equator, to profit from the higher speed of the earth's rotation at equatorial latitudes, or in the far north or south, for easy access to polar orbits. They tend to be situated, then, in places like the Highlands—places that have long been considered peripheral and where the land carries fraught histories of marginalization, oppression, and colonization.

Yet to the crofters, the spaceport has come to represent their independence. Melness will need some development if it is to survive. Faced with a choice between another landowning capitalist and a spaceport, the crofters tend to side with the spaceport.

Despite their disagreements with Povlsen, many residents I spoke to felt profound sympathy for him when, on Easter Sunday 2019, he and his family were among the victims of a bomb attack at the Shangri-La Hotel in Sri Lanka. Three of Povlsen's four children were killed. The church in Tongue held a special service, and the townspeople came out to grieve.

In August 2019, Pritchard and the crofters reached an agreement with the development board: 12 launches per year, for £70,000 (about $85,000) a year in base rent. Objections started to flow in. The Royal Society for the Protection of Birds came out against the project, as did 1,075 signatories of a petition against the spaceport. Povlsen also voiced his disapproval. His 62-page report argued that the spaceport could disrupt bird breeding seasons and damage everything from water quality to the look of the land. It said that another proposed spaceport was in a better location, that the spaceport would harm the peatlands, that the economic benefits had been overstated. Ultimately, the Highland Council's planning committee granted permission for the spaceport in a unanimous decision—but Pritchard did not celebrate. She may have sensed the fight against Povlsen was just beginning.

Povlsen swiftly filed a lawsuit, asking the Scottish Court of Session to cancel permission, and paid the legal fees of three crofters in another legal challenge. "Are we to have no developments along the North Coast unless they have the permission of Mr. Povlsen?" Pritchard wrote on a Facebook page. "To take that sort of opportunity away from our young people is unforgivable."

Then, in November 2020, Povlsen invested £1.43 million in a competing spaceport project in the Shetland Islands. That site is not surrounded by peat bog, but the crofters were outraged. "If it's really an environmental issue," Pritchard said, "why did he go and build a much bigger spaceport with three launch pads and bigger rockets?"

ON A DRIZZLY afternoon last May, I met Thomas MacDonell, Povlsen's director of conservation, in a grand 19th-century country house two and a half hours south of Melness. The building was once the home of a duchess; today it is Wildland's headquarters. Povlsen bought a nearby estate, called Glenfeshie, in 2006, when it was 18,000 hectares of overgrazed and degraded birch and pine forests. MacDonell, having grown up in the area, was eager to help Povlsen rewild.

MacDonell is tall and silver-haired, and he exudes the calm vigilance of a deer stalker. He and I climbed into his black Volkswagen pickup. He drove me around Glenfeshie, gesturing at the landscape and describing how he and Povlsen had culled 15,000 deer and planted 5 million trees, with the goal of encouraging patchworks of ecosystems to exist side by side. They'd

Left: Crofter land outside Melness, near the planned spaceport site.

initially met opposition from sheep farmers and fierce resistance from the owners of hunting lodges, but he endeavored to show me that by now, Wildland's 200-year plan to regenerate Glenfeshie had started to bloom. As we traversed the bumpy gravel paths, MacDonell cast his eyes over the hills, proud that they were thickly carpeted with trees. I saw young and old birches standing together, an indicator of sustainability. Deadwood, MacDonell told me, was providing habitat for woodpeckers and tree creepers.

The next morning we drove toward Kinloch Lodge, an old shooting lodge that Povlsen had transformed into luxury accommodations, a few miles from Melness. It radiated mid-century Scandi immoderation. Everything, down to the shiny brass buckles on a row of smart green canvas backpacks, wafted a mood of comforting, glossed-over extravagance. When I entered the kitchen, I observed a lobster lunch cooking in an antique French oven that MacDonell, unprompted, told me had cost £23,000.

We followed a dirt track to a river, which MacDonell said would soon be shrouded in a cathedral of willow trees, cooling the water. Salmon can't live in water that is too warm, he explained. MacDonell then spotted a fragile plant, hidden in the heather. It was a foot high and looked to me like a birch sapling. "It's probably about 50 years old," he said, examining the tree's delicate stem. Deer had been stunting its growth for half a century.

Here, a 20-minute drive from the spaceport site, the landscape did seem to be finally spluttering back to life. MacDonell told me that Wildland's opposition to the spaceport in Melness was rooted in preserving this fragile regrowth. But he admitted that the aesthetics were also a concern. Povlsen does not like certain signs of civilization to be visible on his land. Wildland dug trenches to bury the telephone cables that run across Glenfeshie. A spaceport was totally incompatible with Povlsen's efforts to turn the area into a sanctuary for lavish ecotourism—a place, as Wildland's marketing copy puts it, "where the world can't find you."

In August and September 2021, the Scottish courts sided with the spaceport. Povlsen continued to invest in his rewilding and ecotourism projects in the area, but he did not appeal. It was a win. The crofters, expelled centuries ago from the fertile valleys to the wild coasts, where locals are increasingly priced out by tourists, had fought back against the country's richest landowner. For once, they had won.

WHEN I MET Pritchard and three other directors last May, they were fresh from the Orbex factory near Inverness, where they had seen the rocket for the first time. Pritchard had offered to take me to the spaceport site, so I trailed her car south along the Kyle, past the Melness graveyard, and onto the road that traverses the Moine. After a few miles, we pulled into a small rest stop on the side of the road. The Flow Country's great carbon sink stretched out to the south. I wiped the rain off a pair of binoculars and focused on a spot a couple of kilometers north of the road. Orbex now has several launch contracts with satellite companies, and there, above a patch of darker bog, I saw a small hill where, later this year, construction on the spaceport will begin.

The wind was vicious, and convoys of supercars were zipping past at frightening speeds. The road across the Moine forms part of the North Coast 500 scenic route, another regional development scheme and a magnet for Ferraris and Lamborghinis. (Povlsen is a major investor.) We sheltered in Pritchard's vehicle, which shook from the extravagant traffic. She cast her eyes over the sea of heather to the mountains. "I don't think this is a ruined landscape," Pritchard said. "Crofters have been managing this land sustainably for generations."

Will the spaceport save Melness? For a community that has long been a forgotten corner, the promise of a cosmic horizon has metaphorical force. It may not, however, be the fix locals are counting on. The new Scottish space industry is enriching the high-tech economies of cities like Inverness, but it is doubtful that the first wave of engineering jobs will go to locals, as Pritchard hopes, due to a lack of relevant expertise. Ultimately, it is difficult to justify increasing the threats to the fragile carbon sink. Plus, NASA has found that as many as one in 20 rocket launches end in failure; to those under the azimuth, that is not a reassuring number. And yet, in spite of all of that, Sutherland Spaceport, as it is now known, represents a rare victory for the downtrodden in one of the most unequal parts of the Western world.

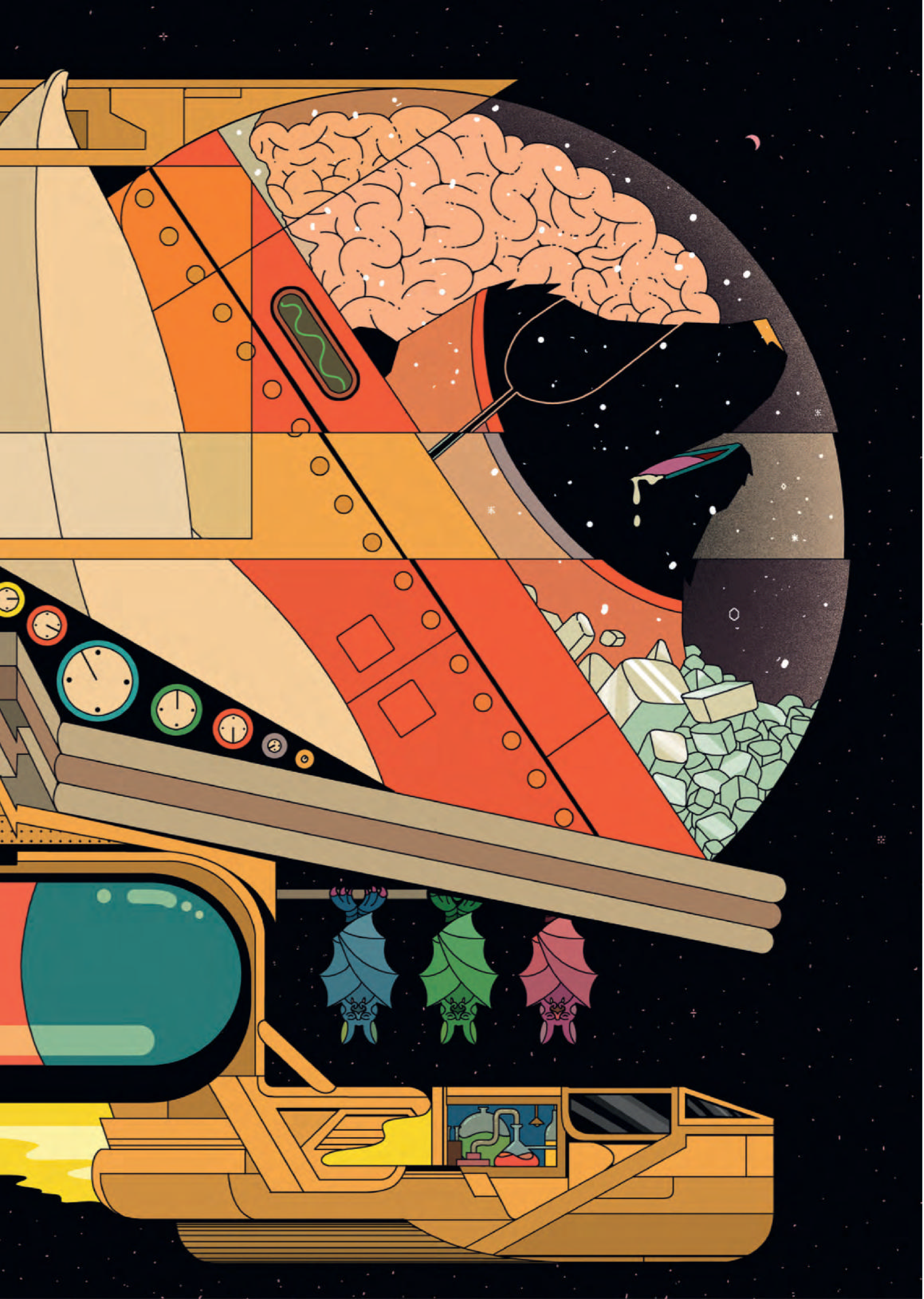
On my last day in Melness, the rain hesitated, so I hiked up to the ruin of Castle Varrich, now owned by Wildland. The path up the hill to Clan Mackay's ancient tower leads through a Povlsen birch woodland. Swallows were diving above streams fringed with purple wildflowers, and bees hummed in the sunny clearings. The forest was scattered with wind-felled trees, roots swinging in the breeze, which somehow managed to keep growing. I stepped into the castle, which Wildland had restored in 2018, and climbed up a metal staircase to a viewing platform, installed by Wildland. At the top I had a clear view of the Moine. On launch days, it occurred to me, there would be few spots better than this one—the wind-battered stronghold of Clan Mackay turned jewel of Wildland Ltd.—to watch a rocket ascend into the thermosphere.

TOMAS WEBER *is a freelance writer in London.*

The Hibernator's guide to the galaxy

STORY BY
BRENDAN I. KOERNER

ILLUSTRATION BY
ORI TOOR



ONE DAY IN 1992, near the northern pole of a planet hurtling around the Milky Way at roughly 500,000 mph, Kelly Drew was busy examining some salmon brains in a lab. Her concentration was broken when Brian Barnes, a zoophysiology professor from down the hall at the University of Alaska Fairbanks, popped by. With a mischievous grin, he asked Drew—a neuropharmacologist early in her career—to hold out her hands and prepare for a surprise. A moment later, she felt a hard, furry lump deposited in her palms. It was some sort of brown rodent with dagger-like claws, curled up into a tight ball and so cold to the touch that Drew assumed it was dead. To her astonishment, Barnes gleefully explained that it was actually in perfect health.

The creature, an Arctic ground squirrel, was just hibernating, as it does for up to eight months of the year. During that span, the animal's internal temperature falls to below 27 degrees Fahrenheit (-2.7°C), literally as cold as ice. Its brain waves become so faint that they're nearly impossible to detect, and its heart beats as little as once per minute. Yet the squirrel remains very much alive. And when spring comes, it can elevate its temperature back to 98.6 degrees in a couple of hours.

Drew cradled the unresponsive critter in her hands, unable to detect even the faintest signs of life. *What's going on inside this animal's brain that allows it to survive like this*? she wondered. And with that question, she began to burrow into a mystery that would carry her decades into the future.

Left: An Arctic ground squirrel—the most extreme hibernator on the planet—can spend up to eight months a year in a torpid state. The animal's internal temperature falls below 27 degrees Fahrenheit, its brain waves become so faint that they're nearly impossible to detect, and its heart beats as little as once per minute.

PHOTOGRAPH BY MARY WEBB

AT THIS POINT, in the year 2022, no fewer than three major entities—NASA, the Chinese National Space Administration, and SpaceX—are vying to put the first human on Mars by 2040 or so. To win that race, a team must first solve a series of vexing design riddles. As an executive at SpaceWorks, an Atlanta-based engineering firm that tackles ambitious research projects for NASA, John Bradford has spent the past decade running the brutal math on one of them.

Unfortunately for the engineers trying to get humans to the Red Planet, we're a pretty high-maintenance species. As large endotherms with active brains, we burn through copious amounts of food, water, and oxygen in our daily quest to survive. All that consumption makes it extra hard to design a spacecraft light enough to reach—and eventually return from—a planet some 140 million miles from our own. Based on the eating habits of the astronauts aboard the International Space Station, for example, a crew of four will need at least 11 tons of food to complete an 1,100-day mission to Mars and back. Those meals alone would weigh nearly 10 times more than the entire Perseverance rover, the biggest payload ever to reach the Martian surface. Add in all the other life-support essentials, to say nothing of the engines and the tools necessary to set up camp, and the weight of a fully fueled Mars-bound ship could easily exceed 330 tons as it departs Earth's atmosphere—more than two fully grown blue whales. It's nearly impossible to see how a vessel that massive could generate the power necessary for its entire round-trip journey.

The obvious solution to this problem—at least to anyone who's read any Arthur C. Clarke novels or watched Stanley Kubrick's *2001: A Space Odyssey*—is to slow the metabolism of crew members so they only need to ingest a bare minimum of resources while in transit. In *2001*, astronauts lie down in sarcophagus-like hibernation pods, where their hearts beat just three times a minute and their body temperature hovers at 37 degrees Fahrenheit. Bradford has devoted a huge chunk of his 21-year career at SpaceWorks to investigating a question that Kubrick had the artistic license to ignore: How, exactly, can we safely power down a human body so it's just one step removed from death, then revive it on demand?

UNFORTUNATELY FOR ENGINEERS TRYING TO GET HUMANS TO THE RED PLANET, WE'RE A HIGH-MAINTENANCE SPECIES.

BECAUSE SO MANY HIBERNATORS ARE OUR CLOSE GENOMIC COUSINS, THERE IS GOOD REASON TO BELIEVE THAT WE CAN TWEAK OUR BRAINS AND BODIES TO MIMIC WHAT THEY DO.

Early on in his research, Bradford glimpsed some promise in therapeutic hypothermia, a medical technique in which people who have experienced cardiac arrest are chilled—typically with intravenous cooling fluids—until their internal temperature reaches as low as 89 degrees Fahrenheit. This decreases their metabolism so much that their cells can function on roughly 30 percent less oxygen and energy—a lifesaver for a damaged body that's struggling to heal amid reduced blood flow. Patients are usually kept in this hypothermic state for only a day or two, mostly because the cold triggers intense shivering that must be controlled with powerful sedatives and neuromuscular-blocking drugs. But Bradford identified a few rare cases in which patients were kept hypothermic for as long as two weeks. "And we started asking, why can't you do that for longer?" he says. "How long can you sustain that comatose-like state?"

Bradford was wary of going public with his curiosity, fearing he'd be branded a crank for suggesting astronauts be put on ice—a concept uncomfortably similar to the one touted by the dubious cryonics industry. But in 2013 he persuaded NASA's Innovative Advanced Concepts program to fund a project assessing the feasibility of "human torpor." His successful pitch centered on the potential weight savings: He estimated that if astronauts could be kept frigid for the bulk of their trip to Mars, the mass of their life-support resources could be cut by as much as 60 percent. Bradford also hypothesized that torpor could help astronauts fend off a number of serious health hazards, ranging from radiation to the psychological perils of extreme boredom and isolation. ("You're

Left: Kelly Drew has been studying the brains of hibernating Arctic ground squirrels since 1992.

in the blackness of space, you don't have real-time communications," he says. "A lot of people will say, 'Oh, I'll just read a lot of books.' But I think that will get old quick.")

Yet as Bradford and his team dug into the minutiae of therapeutic hypothermia, they steadily soured on the technique. There seemed to be no getting around the fact that the drugs used to control shivering also stop respiration. Torpid astronauts would have to be intubated, meaning they'd have to spend weeks or months breathing through tubes shoved down their tracheas. Bradford also balked at the number of needles required to keep the IV fluids flowing, a situation that seemed likely to increase the odds of infection.

The dream alternative was for astronauts to be able to swallow a pill, then lie down for a long and chilly slumber during which they could breathe on their own. It seemed a fantastical proposition, but aspects of it struck Bradford as familiar. There are, after all, scores of species that go torpid every winter, drifting into an unconscious state that drastically squelches their bodies' cravings for food and air. When they rapidly whirr back to life in spring, these creatures show no signs of suffering from muscle atrophy, malnourishment, or other ailments that might be expected to stem from lengthy spells of idleness. Bradford suspected there might be useful wisdom to be gleaned from understanding how such animals switch into low-power mode when their environments turn harsh.

And so Bradford began to seek counsel from the small community of hibernation researchers, scientists devoted to studying the bears, bats, and lemurs for whom regular torpor is a fundamental aspect of existence. In recent years, these researchers have been piecing together the molecular changes that occur when certain species ratchet down their metabolism. And since so many hibernators are our close genomic cousins, there is good reason to believe that we can tweak our brains and bodies to mimic what they do.

By then, the University of Alaska's Kelly Drew had been researching the Arctic ground squirrel, the most extreme hibernator on the planet, for more than 20 years. When Bradford first connected with her in 2015, she was fresh off a major breakthrough—a vital first step toward giving humans the power to turn themselves off and on at will.

AS INTRIGUED AS SHE WAS BY THE DRUG'S EFFECTS ON SQUIRRELS, IT HAD A DOWNSIDE: SHE HAD TO INJECT IT DIRECTLY INTO THE ANIMALS' BRAINS.

WHEN DREW LEFT Alaska after college in 1982, she assumed she'd never live there again. She had moved to Fairbanks in her teens so that her father, a prominent soil scientist, could take a professorship at the state's flagship university. Though Drew loved Alaska's desolate beauty, she had her sights set on a scientific career that wasn't linked to the wilderness. So at the age of 22, she decamped to New York to earn a doctorate in pharmacology, then to Sweden for a postdoc studying how brain metabolism affects human behavior.

But shortly after her daughter was born in 1990, Drew and her husband, whom she'd met in college, felt the gravitational pull of their home state. Like so many overwhelmed new parents, they suddenly warmed to the idea of being close to family. So even though Drew didn't have a job lined up, she agreed to return to Fairbanks—a decision that bewildered her Swedish coworkers. "I mean, they seriously just laughed and went, 'Well, that's the end of your career,'" Drew recalls.

It didn't take long for her to conclude that the naysayers might have been right. She had assumed she'd be able to snag a few grants to continue the work she'd been doing in Sweden, but no one seemed eager to dole out money to a young, unaffiliated researcher based in a remote northern outpost. With each rejection, she became more certain that her homecoming had been a horrendous mistake.

After a year's worth of failures, Drew finally landed a small National Science Foundation grant with a very Alaskan twist: She was commissioned to study the neurochemistry of coho salmon. She used that gig to talk her way into borrowing a few square feet of lab space in the university's Institute of Arctic Biology—a toehold back in academia that she hoped would lead to bigger things.

It did, though in a most unexpected way. It was during the salmon study that Brian Barnes first plunked an Arctic ground squirrel into Drew's hands. Instantly curious about what was taking place inside the critter's brain, a topic that had scarcely been researched, Drew began to examine hibernating ground squirrels using microdialysis, a technique in which tiny tubes are inserted beneath a living creature's skull to harvest samples of neural chemicals. The procedure normally causes scarring in the places where the tubes come in contact with the brain. So Drew was stunned when she couldn't detect any such damage after performing microdialysis on the torpid squirrels.

"You couldn't even find where the probe had been," she says. "And so we started talking about hibernation as being a very protected state—it really seemed to protect the brain from injury." This revelation made Drew think there could be tremendous value to replicating that state in humans.

Right: Kelly Drew in her lab at the University of Alaska Fairbanks.

FOR A BRIEF moment early in the Cold War, hibernation research flourished in the United States. With the federal government fixated on besting the Soviet Union at every turn, there was plenty of money sloshing around to fund scientists who claimed their work could give the US any sort of biological edge. Many of these researchers passed through military facilities located in or near the Arctic, where there was ready access to all manner of animals that have evolved the means to power down for winter.

Among this group of scientists was Raymond J. Hock, a zoologist who'd written his doctoral thesis at Cornell University about the metabolic rates of hibernating bats. In the mid-1950s he wound up at the Arctic Aeromedical Laboratory in Fairbanks, where Air Force scientists were scrambling to make American soldiers immune to cold. (In one ethically shaky experiment, the lab's personnel paid several Indigenous inhabitants of Chilean Patagonia to wear temperature sensors and ventilated plastic hoods while they slept in freezing canvas tents.) Hock developed a keen interest in bears during his stint in Fairbanks, and he lamented how little was known about the changes in the animals' metabolism during hibernation. So he mustered the courage to creep into the sleeping bears' dens and stick thermometers in their rectums, a gambit that allowed him to assess just how much their internal temperature declined during their annual torpor.

In 1960, Hock published a paper entitled "Potential Application of Hibernation to Space Travel" that offered the first sober, detailed look at how the budding American space program might benefit from the research he was helping to pioneer. Hibernation was within our grasp, he argued, the major hurdle being the human heart's sensitivity to rapid temperature fluctuations. "The hibernators have learned how to do this, and several laboratories are currently working on ways to avoid it in man," he wrote.

Hock also noted that hibernation has the potential to slow aging. "A hibernator, with its greatly reduced annual energy expenditures, will live longer than a non-hibernating mammal of the same body size," he asserted. If humans, like bears, were able to maintain an internal temperature about 13 degrees colder than normal, he estimated that "aging should occur at half the normal rate during this period."

In the early 1960s, while working at UCLA's White Mountain Research Center in California, Hock and his colleagues subjected hibernating marmots to sudden blasts of extreme cold. They discovered that the animals' brown fat—a type of tissue humans also possess—generated heat in response to the shock. Hock's team saw this as the key to enabling humans to survive frigid torpor: We needed to unlock brown fat's innate power to keep our internal organs functioning as our metabolism slowed.

But Hock died in a tragic accident in 1970. And as the Cold War matured, hibernation research fell out of fashion. With funding from the Pentagon and NASA at an ebb, biologists came to think of the field as a backwater. Since it takes a full year to gather data about an annual hibernation cycle and then compare it to an animal's normal activity, the research tends to be agonizingly slow. "It's a gamble for a young professional scientist," says Barnes, who introduced Drew to ground squirrels in 1992 and was the Institute of Arctic Biology's director from 2001 until 2021. "You're not going to have the same number of publications as you would in a different field."

But Drew, whose kindly demeanor belies her tenaciousness, was so captivated by the Arctic ground squirrel that she plunged into hibernation studies with zeal. She took to camping out on the North Slope each summer so she could trap squirrels by the dozen for her lab. (Accustomed to lives of deprivation, the animals are hopeless suckers for the carrots she uses as bait.) She secured funding from the US Army's research office, selling them on the idea of saving badly wounded soldiers by safely and rapidly cooling their bodies on the battlefield. To make that happen, she needed to identify the chemicals that trigger hibernation in Arctic ground squirrels, then test whether those might have a similar effect in humans.

Drew, who became an assistant professor at the Institute of Arctic Biology in 1993, initially hypothesized that gamma-aminobutyric acid, a neurotransmitter commonly known as GABA, was chiefly responsible for sparking hibernation in her squirrels. GABA is integral to inducing sleep, the state in which a non-hibernating animal's metabolism is typically at its lowest. (Humans' normal metabolic rate falls by 15 percent while we doze.) And hibernation, for all its com-

ONE ZOOLOGIST MUSTERED THE COURAGE TO CREEP INTO THE SLEEPING BEARS' DENS AND STICK A THERMOMETER IN THEIR RECTUMS.

plexities, is essentially just a very deep form of sleep—a state in which respiration is lowered, appetite is suppressed, and waste expulsion is controlled. (Bears, for example, typically do not defecate or urinate throughout their winter torpor.)

But when Drew dosed her squirrels with GABA and an array of related chemicals, none brought about any sort of stable, long-term torpor. Years slipped by in this frustrating manner: Drew celebrated her 40th birthday, mentored dozens of graduate and undergraduate students, and watched her daughter become a teenager while her efforts to find the molecular key to hibernation remained mostly stuck in neutral.

IN 2005, A DOZEN or so years into Drew's research on the squirrels, an undergraduate chemistry major named Benjamin Warlick joined her lab as an assistant. One of his duties was to scour databases in search of fresh ideas about the chemicals that might activate ground-squirrel hibernation. Among the many papers he unearthed was an obscure one from Japan's Fukuyama University entitled "Phase-Specific Central Regulatory Systems of Hibernation in Syrian Hamsters." Though the main text was entirely in Japanese, a language that Warlick doesn't know, the brief abstract was in English. That paragraph mentioned that the authors had snapped their hibernating hamsters out of torpor by administering a drug that blocked the A1 adenosine receptor in the animal's cells. Though that was the opposite of what Drew was trying to accomplish, Warlick flagged the paper for his boss as worthy of a glance.

Two years passed before Drew got around to having the document translated in full. But when she finally read the English version in 2007, an idea struck her: If blocking the A1 adenosine receptor caused hibernating hamsters to stir, perhaps activating it in her squirrels would induce torpor.

Sure enough, when she dosed her ground squirrels with CHA, a drug well known for stimulating the A1 adenosine receptor, the animals promptly cooled down and began to hibernate. This happened only if they received the drug during the winter months, a sign that something else was going on in the squirrels' brains that kept them on an annual hibernation schedule. Still, Drew was encouraged enough to begin working on a paper for *The Journal of Neuroscience* about the drug's mechanism of action in the Arctic ground squirrel.

As intrigued as she was by CHA's effects in her squirrels, however, the drug had a major downside: She had to inject it directly into the animals' brains. When administered intravenously, CHA is notorious for affecting the A1 adenosine receptors in the heart, slowing the organ until it stops beating altogether. As a result, CHA seemed like it could only ever be of limited use in humans: It's rarely advisable to stick needles into someone's brain, particularly outside of a hospital setting.

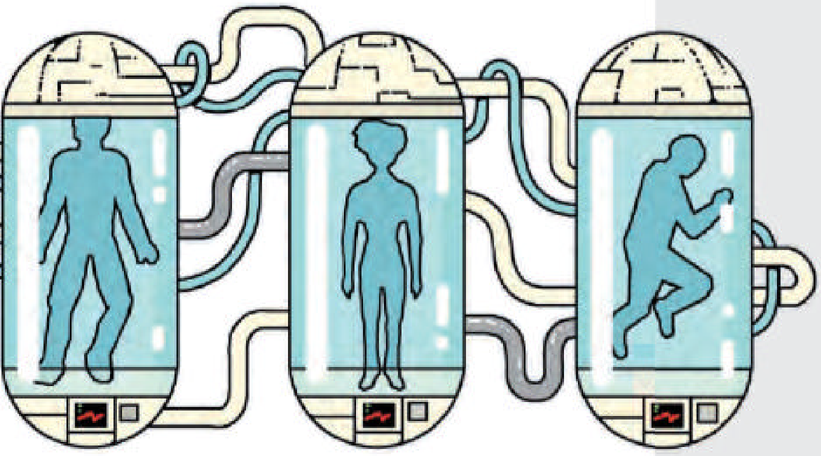
In 2011, while putting the finishing touches on her *Journal of Neuroscience* paper, Drew had a poster made of all the data she hoped to include in the article. She hung it in the hallway outside her lab so she could review the numbers whenever she walked by. But as she paused by the tables of data one day, she was struck not by how much she'd accomplished, but by how much knowledge still eluded her. Nearly two decades after Barnes had first placed a frigid squirrel in her hands, she hadn't devised a way to turn her esoteric expertise into the safe and effective drug she'd envisioned. What should have been a moment of triumph instead felt like a minor defeat.

And then in the midst of her melancholy, a thunderbolt hit: What if Drew could combine the CHA with another drug that would block its effect on the heart, but not the brain? CHA is what's called an agonist, meaning it stimulates receptors; a drug that blocks them is an *ant*agonist. What Drew needed, she realized, was an A1 adenosine antagonist with molecules too large to cross the permeable blood-brain barrier.

"If you think of the body as a color map, and of agonist as red, then the agonist—the red—is everywhere. It's stimulating all the receptors," Drew explains. "Now, you don't want it to stimulate the heart receptors, so you have to block those receptors. Now, think of the *antagonist* as blue. So you put that in the body, but it doesn't get into the brain, right? So the rest of the body is purple, but the brain is still red."

There was already an extensive literature on A1 adenosine antagonists, so Drew had several good candidates to choose from. She ultimately settled on 8-(p-sulfophenyl)theophylline, or 8-SPT, which is closely related to one of the main ingredients in black tea. She melded this with CHA into a drug cocktail that was injected into the abdomen. To test this combination, Drew then launched a series of experiments on rats. She would stop the rats' hearts, then revive them by performing CPR. Once pulled back from the brink of death, the rats were then either made hypothermic with the CHA/8-SPT combination or left to heal with their metabolism at a normal rate. The rats that received the cocktail fared much better than the ones that didn't. And perhaps most significantly, the treated rats suffered no ill effects from having their thermostats turned way down by the drug. There was no shivering, and thus no reason to give any narcotics that might interfere with their breathing.

By 2014, Drew had achieved such excellent results in her experiments on rats that she applied to patent her invention: "Methods and compositions for the treatment of ischemic injury to tissue using therapeutic hypothermia." The first illustration in the application is a photograph of an Arctic ground squirrel curled into its trademark hibernation pose, a nod to the small moment in 1992 that had altered the course of her life.



FROM AN ORDINARY familiarity with sci-fi movies like *2001* and *Planet of the Apes*, Drew was always vaguely aware that her work might attract interest from the space-exploration industry. So she wasn't terribly surprised when someone from SpaceWorks reached out to her in February 2015. The firm had just secured a second tranche of NASA funding to press forward with its human-torpor research, and John Bradford invited Drew to become his company's chief hibernation consultant.

SpaceWorks arranged for Drew and Matthew Kumar, an anesthesiologist at the Mayo Clinic, to test the CHA/8-SPT cocktail on pigs. The drugs steadily and safely lowered the animals' internal temperature to between 86 and 90 degrees Fahrenheit—not quite as chilly as the state doctors can achieve using intravenous fluids on humans, but close. In his summary of the experiment, Bradford wrote that the cocktail "could lead to a torpor induction protocol that does not require any active cooling [and] eliminates the need for pharmacological sedation to suppress shiver response."

Drew was not the only hibernation researcher shifting her focus to Mars around this time. In 2017, a University of Colorado biologist named Sandy Martin, who had spent her career building a tissue bank containing samples from various hibernating species, was approached by students organizing a one-day symposium on space travel. They urged her to talk about whether her life's work could be used to facilitate human torpor on long voyages. "I had never thought seriously about it," Martin says. "I mean, it's always in the back of your mind as a hibernation researcher, what the applications might be, but that was never the motivation for me. My motivation was, 'This is a profound evolutionary adaptation.' I mean, for a mammal to be so plastic in terms of body temperature, and the ability of cells to survive hypoxia and temperature swings, all that is just so profound." In preparing for her talk, Martin unearthed an older SpaceWorks paper that advocated using IV cooling fluids to place Mars-bound astronauts in torpor. She forwarded the paper to her daughter, an emergency medicine resident who dismissed SpaceWorks' proposal as "ridiculous" due to the pesky shivering problem.

"I thought, 'What we need to do is figure out how hibernators do this, because they do it so beautifully and so naturally and without harm,'" Martin recalls. "And they don't need intubation, and they don't need feeding tubes." She and her daughter began working on their own paper, proposing several promising avenues of inquiry based on Martin's genomic analysis of the thirteen-lined ground squirrel, a close relative of the Arctic ground squirrel. One was to investigate further a receptor called TRPM8, which plays a crucial role in helping thirteen-lined ground squirrels thermoregulate during hibernation.

In March 2018, NASA invited Drew, Martin, and a handful of other luminaries from the hibernation community to a two-day conference in Mountain View, California—an event billed as the agency's first-ever "space torpor workshop." The meeting was an opportunity for the biologists to make the argument that, if provided with sufficient backing, they could help humans achieve at least some level of true hibernation in the next 10 to 15 years—a timeline that dovetailed nicely with NASA's plans to send humans to Mars in the late 2030s or early 2040s.

Speaking to NASA officials at the workshop, Martin emphasized that the pervasiveness of hibernation among mammals suggests humans can achieve it too. There are three types of mammals: the egg-laying monotremes, such as the platypus; the marsupials, which carry their undeveloped offspring in pouches; and the placentals, the category that includes us. "All three of those branches have hibernating species," Martin says. "The most parsimonious explanation for that is that our common ancestor was a hibernator." Assuming that's the case, preparing our species to deal with the physiological stresses of torpor may simply be a matter of altering genes we already possess.

Four months after the NASA workshop, SpaceWorks published the final report from the second phase of its human-torpor project. The 115-page document is frank about the many challenges that lie ahead: Bradford and his coauthors admit that little to nothing is known about how hibernation might affect an astronaut's cognitive abilities, for example. But the report also asserts that, based on the current pace of research, NASA could begin testing hibernation technologies such as Drew's drug cocktail on human subjects as early as 2026. Judging by investments that NASA has initiated in recent months, the agency seems intent on making that happen.

NASA HASN'T JUST started to accept that torpor is essential to making spaceships lighter. The agency has also come around to Bradford's view that it may help astronauts avoid some of the physical hardships of long-haul space travel. One of the great unknowns about the mission to Mars, for example, is whether humans can endure the ravages of galactic cosmic rays, the remnants of the Milky Way's celestial violence. Once a spacecraft travels beyond Earth's protective magnetosphere—which orbiting craft like the International Space Station stay well within—there's no real way to dodge these cancer-causing particles, and scientists have yet to find a malleable, lightweight material that can shield against them. But if human cells can be made less active, they may develop significant resistance to radiation. In a 1972 experiment, for example, scientists found that ground squirrels that were irradiated while hibernating had a much higher survival rate than their fully conscious peers.

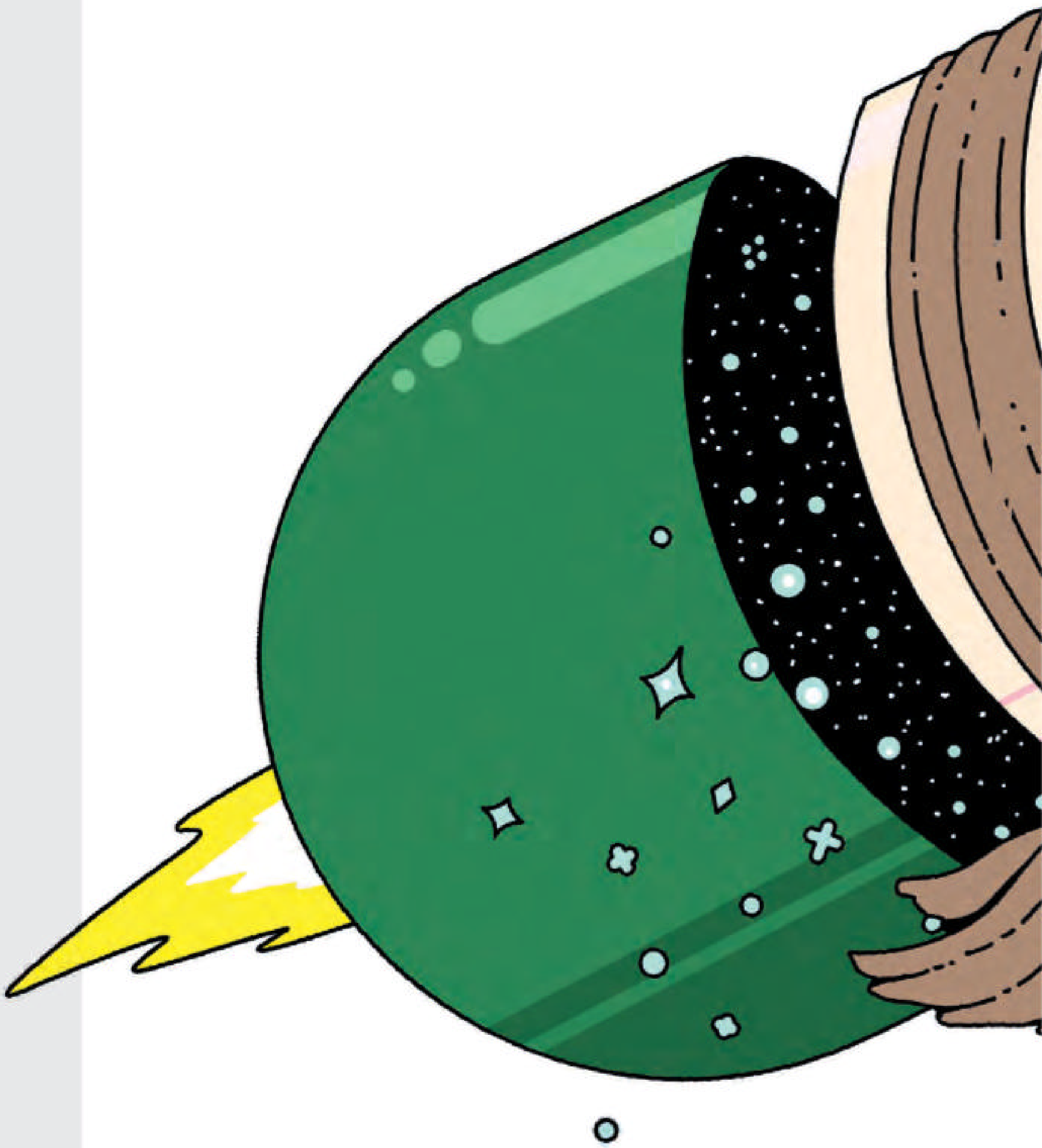
"The hypothesis is that if you reduce the metabolism in the cells, then you would also reduce the damage from radiation," says Emmanuel Urquieta, chief medical officer for the Translational Research Institute for Space Health, a NASA-sponsored program based out of Baylor University's College of Medicine. "So you can give the cells a little bit more time to start repairing themselves from radiation exposure."

In August 2021, Urquieta's institute awarded $4 million to researchers interested in furthering the science of human torpor. One of the recipients is now examining the fossilized remains of an extinct human species that may have hibernated in the caves of northern Spain some 430,000 years ago. Another awardee is trying to establish the ideal temperature at which humans can hibernate without causing undue physiological stress. And Clifton Callaway, a professor of emergency medicine at the University of Pittsburgh, is deepening his investigation into drugs that might be used as part of a suspended-animation system on long-haul space flights.

Like Bradford, Callaway's early interest in human torpor grew from his curiosity about therapeutic hypothermia. He has long wanted to use the technique to help not just survivors of full-blown cardiac arrest but also people who walk into the ER exhibiting the early signs of heart attacks. To help make therapeutic hypothermia a realistic option for such patients, Callaway looked for drugs that can prevent shivering without knock-

Above: **Drew holding an Arctic ground squirrel in her laboratory.**

IN AN ODD WAY, HIBERNATION MAY TURN OUT TO BE THE ONLY REMOTELY ATTAINABLE FORM OF TIME TRAVEL.



ing vital organs out of commission. Just before the Covid-19 pandemic hit, he obtained some encouraging results with dexmedetomidine, a mild sedative used in anesthesia. “It worked well enough that we actually said, ‘God, you really could use this in astronauts,’” he recalls.

Pure dexmedetomidine probably doesn’t have much of a future aboard spacecraft, since its sedative effects last only 30 minutes and it must be administered intravenously. But there are a host of closely related drugs that Callaway is testing on human subjects, hoping to find one that can be delivered via pill or patch. Next year he plans to expand his work to assess how well our species can rebound from an extended period in a low-metabolic state.

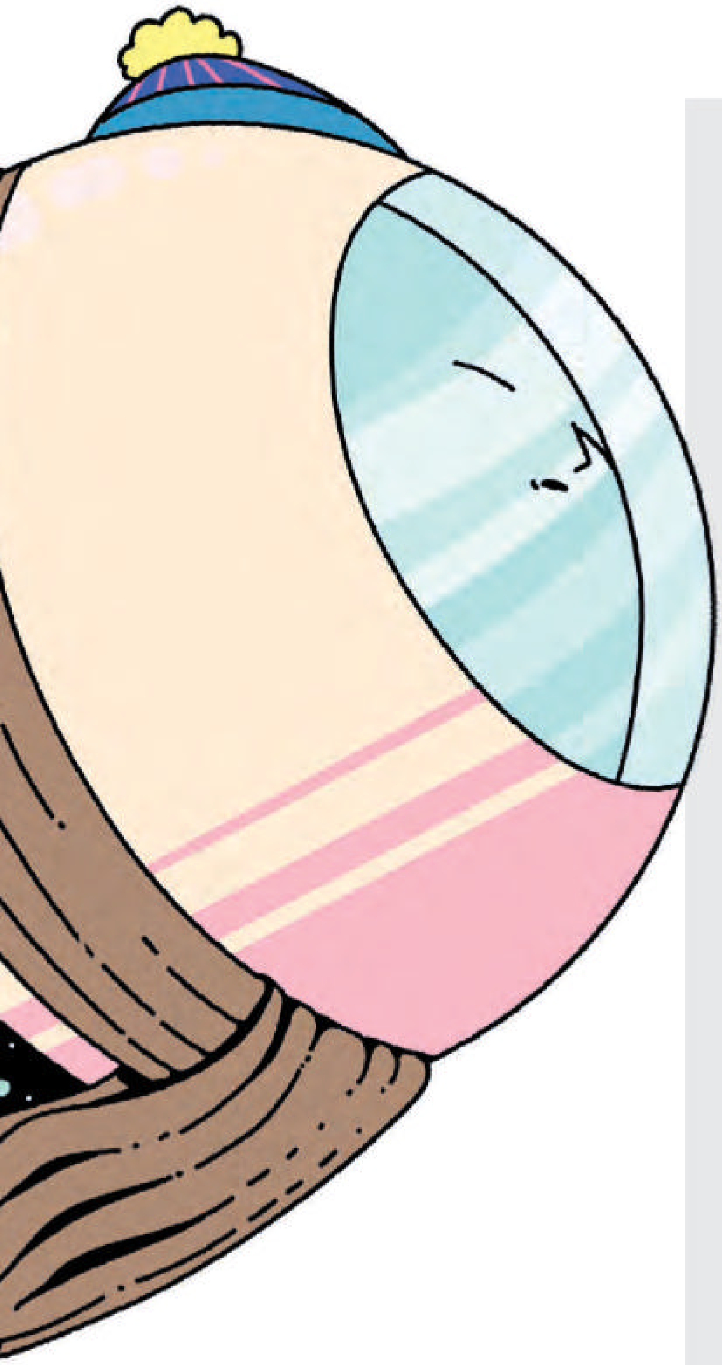
“Our master project is to take eight or 10 people and have them do a torpor for five days,” Callaway says. “I want them to sleep 20 hours a day, have a slightly lower body temperature, use less oxygen and consume fewer calories, and make lower carbon dioxide for five days. And we’re going to do a whole bunch of testing before they start and after they finish to see, you know, what’s the hangover?”

Callaway does not yet know how he plans to make his test subjects torpid, but he is well aware of the innovations coming out of Kelly Drew’s lab in Alaska. Drew paid him a visit in 2019 and opened his eyes to the possibilities of taking inspiration from animal hibernators. “One lesson I’ve gotten from the physiologists studying hibernation is that we would be very naive to think that we’re going to find one single drug that just lets an animal or a person go into hibernation,” Callaway says. “I imagine in 10 years, the answer we’ll be looking at will be maybe one of the drugs in the class I’m studying right now, in combination with a drug that Dr. Drew is studying, and then another drug some other sleep researcher is studying. It’ll be that cocktail of drugs that’ll be most likely to provide astronauts with a safe sleep for a long distance.”

Callaway doubts that when those astronauts sleep they’ll ever get as cold as the Arctic ground squirrel or have metabolisms as low. But he notes that bears are pretty effective hibernators too, and they reduce their internal temperature by only a few degrees while snoozing through a winter. “In this decade,” he says, “we can replicate that.”

SOMETIMES DREW CANNOT believe that, at the age of 63, she has devoted nearly half her life to trying to determine how a 3½-pound rodent shuts down for the winter. She counts herself fortunate to have been able to crack problems at such a meticulous pace. “When you talk to people in industry, I mean, they just, they would never tolerate this,” she told me, with a self-deprecating chuckle.

But thanks to university-based researchers like Drew who’ve solved



some of the fundamental mysteries of hibernation, the private sector is taking notice of its potential. When the University of Colorado's Sandy Martin retired last year, she arranged for her bank of hibernator tissues to be licensed to a former student, a computational biologist named Katie Grabek. Grabek then cofounded FaunaBio, a Silicon Valley startup that aims to improve treatments for heart and lung diseases by discovering why hibernators can survive stressful events—particularly the abrupt shocks to internal organs that occur during cooling and rewarming—that would kill most humans.

"These animals, when they arouse from torpor, it's very similar to having a heart attack," Grabek says. FaunaBio wants to identify the molecular compounds that hibernators use to prevent or repair cellular damage, in the hope of developing pharmaceuticals that can help cardiac patients.

But if hibernation does indeed become a realistic option for humans, even those of us in decent shape may find it tempting. Induced torpor seems to offer a roundabout path to realizing at least a couple of transhumanist dreams. Like life extension, perhaps—provided you're not purely bent on extending your *conscious* life. As Raymond J. Hock noted in 1960, hibernation really does seem to offer a fountain of youth. Earlier this year, for example, a team at UCLA found that yellow-bellied marmots, which hibernate for as much as two-thirds of every year, possess much more robust genetic material than might be anticipated based on their chronological ages. "The molecular and physiological responses required for an individual to successfully hibernate may prevent aging," the researchers wrote in *Nature.*

In an odd way, hibernation may also turn out to be the only remotely attainable form of time travel. In a satirical story from 1850, Edgar Allan Poe imagined that the ancient Egyptian practice of mummification was just such a technology. When the story's protagonists accidentally revive a mummy, the awakened Egyptian explains that his civilization's historians sometimes lived their lives "in installments." They would hibernate for a few hundred years, then arouse to correct the record about the era from which they'd originated—a method for "preventing our history from degenerating into absolute fable." Of course, no one today is keen to develop a hibernation cocktail that can induce torpor for centuries. But a biological fast-forward button that would allow someone to skip months or more into the future could have its uses—or, at the very least, appeal to a certain kind of adventurer.

As for myself, what I find most alluring about hibernation is its potential to offer a brief holiday from the constant din of my own thoughts. In a time of exhausting overstimulation, anxiety, and dread, I find myself wondering what it would be like to switch off for a week or two. In his novelization of *2001,* Arthur C. Clarke depicted one of his main characters as longing for the psychological liberation of torpor: "Sometimes Bowman, as First Captain of *Discovery*, envied his three unconscious colleagues in the frozen peace of the Hibernaculum. They were free from all boredom and responsibility."

Then again, the vulnerability of the hibernator is a perennial theme in science fiction. In *2001*, the three astronauts who spend the film sealed in hibernation pods are unceremoniously murdered by HAL 9000, their ship's sentient operating system. Countless other works of sci-fi focus on the shock and social dislocation that long-term hibernators experience when they emerge into worlds that have gone haywire in their absence. Even if we go under for only a few months in order to accomplish a worthwhile endeavor like reaching Mars, reentry into consciousness is bound to be a complicated affair. Arctic ground squirrels snap back to their old selves within hours of warming up. But that might not be the case if they were blessed with human self-awareness.

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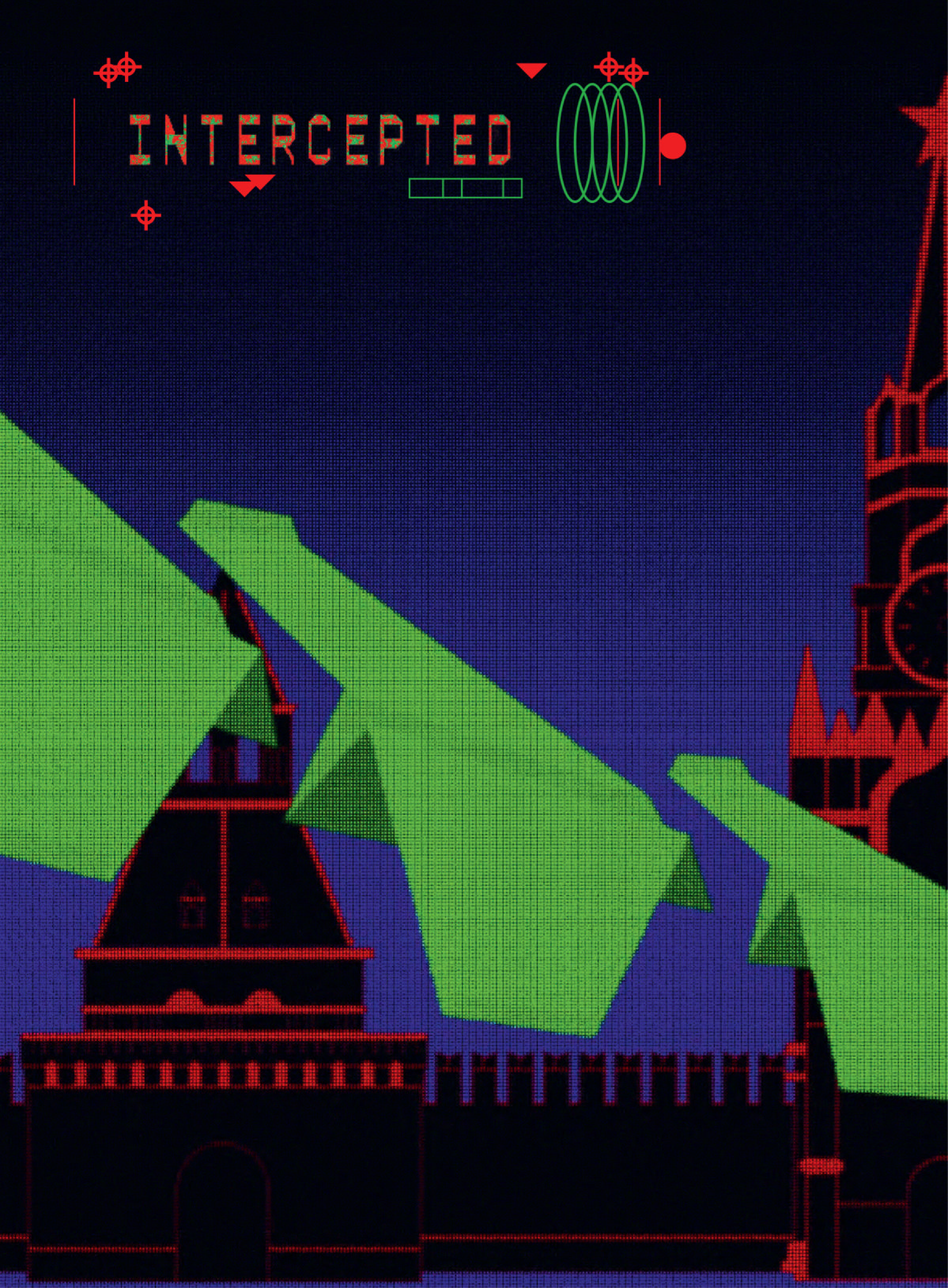
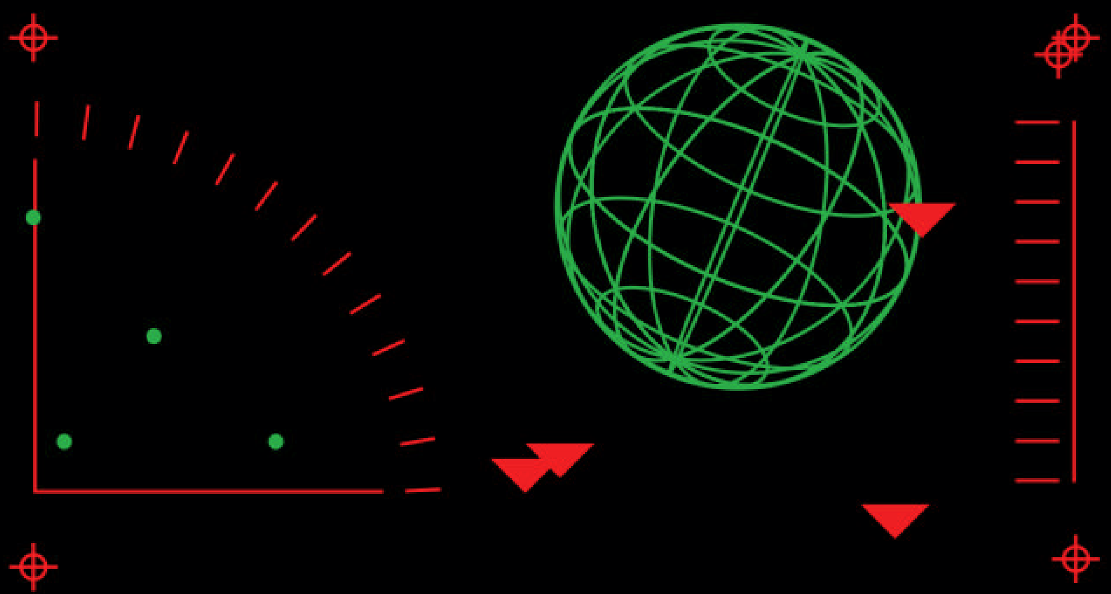

INTERCEPTED

How Telegram became a favorite tool of the Kremlin.

by Darren Loucaides
Illustrations by Irene Suosalo



ON THE CHILLY, clear afternoon of February 24, 2022—the day Vladimir Putin's forces launched their full-scale invasion of Ukraine—a handful of Russian opposition politicians gathered in front of Saint Petersburg's palatial Law, Order, and Security building. They had come to officially request permission to hold a rally opposing the war, which they knew would be denied. Among the group was Marina Matsapulina, the 30-year-old vice chair of Russia's Libertarian Party. Matsapulina understood that the gathering was a symbolic gesture—and that it posed serious risks.

Nine days later, Matsapulina was awoken around 7 am by someone banging at her apartment door. She crept up to the entrance but was too frightened to look through the peephole, and she retreated back to her bedroom.

The pounding continued for two hours, as Matsapulina kept seven friends from her party apprised in a private Telegram group chat. "They're unlikely to bust it down," she wrote, wishfully.

But at 9:22 am, she heard a much louder noise. She had just enough time to lock her phone before the door caved in. Eight people surrounded Matsapulina's bed. They included, she recalls, two city police officers, a two-person SWAT team wielding guns and shining flashlights in her face, and two agents from either the Center for Combating Extremism or the Federal Security Service, or FSB—the successor to the KGB. The officers told her to lie on the floor facedown.

They told Matsapulina she was suspected of emailing a police station with a false bomb threat. But when she was taken into the Ministry of Internal Affairs' investigation department, she says, a police officer asked whether she knew the real reason she'd been arrested. She guessed that it was for her "political activities." He nodded and asked, "Do you know how we knew you were home?"

"How?"

She says the officer told her that investigators had been following along with her private Telegram chats as she wrote them. "There you were, sitting there, writing to your friends in the chat room," she recalls him saying. He proceeded to dispassionately quote word for word several Telegram messages she had written from her bed. "'They're unlikely to bust it down,'" he recited.

"And so," he said, "we knew that you were there."

Matsapulina was speechless. She tried to hide her shock, hoping to learn more about how they'd accessed her messages. But the officer didn't elaborate.

When she was released two days later, Matsapulina learned from her lawyer that on the morning she was arrested, police had searched the houses of some 80 other people with opposition ties and had arrested 20, charging each with terrorism related to the alleged bomb threat. A few days later, Matsapulina gathered her belongings and boarded a flight to Istanbul.

In April, after having made it safely to Armenia, Matsapulina recounted the episode in a Twitter thread. She ruled out the chance that anyone in her close-knit group had been cooperating with security forces (they'd all also left Russia by then), which left two conceivable explanations for how the officers had read her private Telegram messages. One was that they had installed some kind of malware, like the NSO Group's infamous Pegasus tool, on her phone. Based on what she'd gathered, the expensive software was reserved for high-level targets and was not likely to have been turned on a mid-level figure in an unregistered party with about 1,000 members nationwide.

The other "unpleasant" explanation, she wrote, "is, I think, obvious to everyone." Russians needed to consider the possibility that Telegram, the supposedly antiauthoritarian app cofounded by the mercurial Saint Petersburg native Pavel Durov, was now complying with the Kremlin's legal requests.

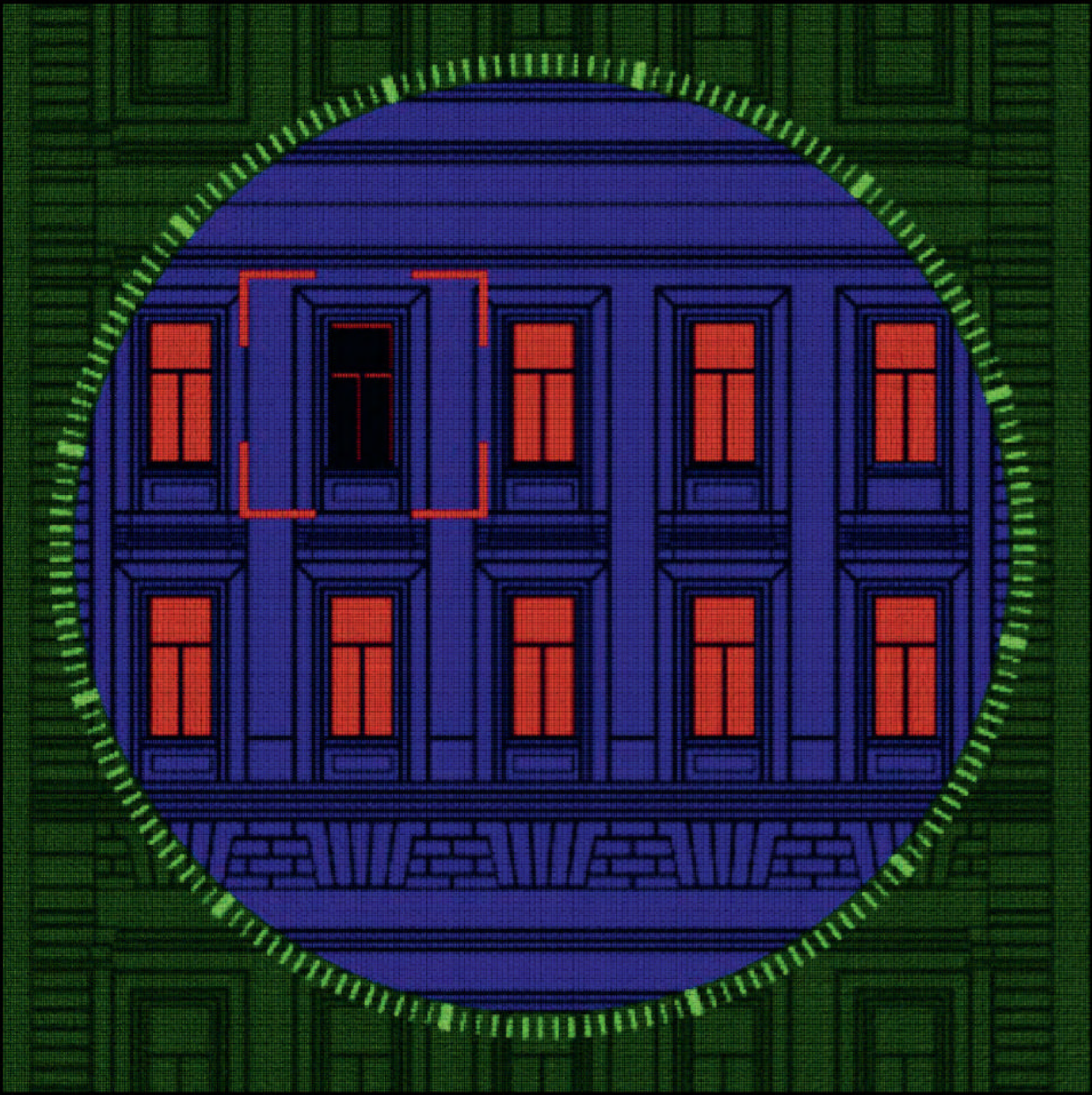
Matsapulina's case is hardly an isolated one, though it is especially unsettling. Over the past year, numerous dissidents across Russia have found their Telegram accounts seemingly monitored or compromised. Hundreds have had their Telegram activity wielded against them in criminal cases. Perhaps most disturbingly, some activists have found their "secret chats"—Telegram's purportedly ironclad, end-to-end encrypted feature—behaving strangely, in ways that suggest an unwelcome third party might be eavesdropping. These cases have set off a swirl of conspiracy theories, paranoia, and speculation among dissidents, whose trust in Telegram has plummeted. In many cases, it's impossible to tell what's really happening to people's accounts—whether spyware or Kremlin informants have been used to break in, through no particular fault of the company; whether Telegram really is cooperating with Moscow; or whether it's such an inherently unsafe platform that the latter is merely what appears to be going on.

In the decade since its founding in Russia, Telegram has grown to become one of the biggest social networks in the world, with 700 million users—yet only about 60 core employees. “For us, Telegram is an idea,” Durov has said. “It is the idea that everyone on this planet has a right to be free.”

The platform, now based in Dubai, has minimal content moderation aside from a stated commitment to taking down illegal pornography, IP rights violations, scams, and calls for violence. Often described in the press as an “encrypted” or “secure” messaging app, Telegram has fashioned itself as a refuge for safe, anonymous communication; but in fact it requires users to go out of their way to set a chat as “secret”; unlike on WhatsApp or Signal, end-to-end encryption is not the default. Still, Durov has repeatedly managed to benefit from the stumbles of other tech giants, particularly when user privacy is at stake. In January 2021, a PR crisis surrounding WhatsApp’s data-sharing with Facebook helped drive millions of people to Telegram, an exodus Durov called possibly the “largest digital migration in human history.”

In the US, Telegram has been relatively slow to catch on, though in the wake of Donald Trump’s ban from Facebook and Twitter in January 2021, it has increasingly become a hotbed for far-right groups like the Proud Boys and followers of QAnon. But in many parts of the world, Telegram is mainstream. In Brazil, where the app has been downloaded on more than half of the country’s smartphones, much of the January 2023 insurrection was planned on the platform. Telegram has also been crucial for pro-democracy activists in Hong Kong and in countries under Russia’s

Additional reporting by Vadim Smyslov



thumb, like Belarus and Ukraine. In the latter, it has become the preferred app for disseminating government advice for avoiding air strikes—as well as for Russian disinformation.

But it is in Russia itself that Telegram has become nearly indispensable over the past year, thanks to the Putin regime's wartime clampdown against Western tech. Since the conflict began, Russian authorities branded Telegram's main rival, Meta, an "extremist" organization, in part for permitting certain users in Ukraine to post calls for violence against the Russian military. Russia then blocked Meta's Facebook (which had some 70 million users in the country) and Instagram (80 million). Telegram's Russian user base has soared from 30 million in 2020 to nearly 50 million today, surpassing WhatsApp as Russia's most used messaging platform. (The Kremlin controls all of the most popular internet companies based in Russia, including VKontakte, a Facebook-like social network cofounded by Durov in 2006 that has nearly 70 million users.)

As soon as the war began, cybersecurity experts raised concerns about Telegram users' exposure to Russian authorities—even users who are outside Russia. On February 24, Moxie Marlinspike, the cofounder of Telegram's US rival Signal, posted on Twitter, "Telegram is the most popular messenger in urban Ukraine. After a decade of misleading marketing and press, most people there believe it's an 'encrypted app.' The reality is the opposite." Aside from "secret chats," Telegram's messages are accessible to people inside the company. "Every msg, photo, video, doc sent/received for the past 10 yrs; all contacts, group memberships, etc are all available to anyone w/ access to that database," Marlinspike tweeted. Elies Campo, who says he directed Telegram's growth, business, and partnerships for several years, confirmed this general characterization to WIRED, as did a former Telegram developer.

In other words, Telegram has the capacity to share nearly any confidential information a government requests. Users just have to trust that it won't.

But in many ways, Russian authorities may not even need Telegram's cooperation to monitor users at scale. That's because Telegram has effectively built that capability into its generous application programming interface. An API is a software portal through which app developers and researchers can essentially jack into a platform and pull data out of it for their own projects. In Telegram's case, that data includes the text contents and metadata from any public group chat or channel, and even a record of when users were last online.

Like most APIs, Telegram's requires a key for access; but those are available to any user who requests one. For years, Durov touted the platform's open API as an emblem of Telegram's commitment to transparency, allowing anyone to inspect Telegram's source code or create automated bots that can, among other functions, broadcast news briefs, process payments, or pass commands to any internet-connected device. But it also makes Telegram a potentially powerful tool for mass surveillance.

Campo, who's now a fellow at Citizen Lab, a research facility that specializes in spyware, says the app's API enables any user to automatically save and catalog a vast amount of public channels and group chats, a function that isn't possible on platforms like WhatsApp and Instagram. This would explain, he says, how authorities might have scraped even small channels by indexing at scale. "Telegram could create security measures to make this more difficult, especially if it suspects the Kremlin is doing this and wants to counteract it—for example, more barriers to bots; barriers that identify whether users joining groups or channels are human or not."

(Campo was quoted extensively in a 2022 WIRED story about Telegram's global rise. The company claimed, after that story's publication, that Campo had never been employed by Telegram and was only briefly a volunteer. Campo provided WIRED with documentation from 2016 to 2021 that included copies of email correspondence he carried on, using a Telegram address, with executives at Apple, Spotify, and Stripe on behalf of Telegram, and copies of contracts between Telegram and other companies with Campo's signature. Durov was also included in the correspondence.)

As for the access its API offers to public channels, "Telegram gives you pretty much anything," says Jordan Wildon, an investigator at the Institute for Strategic Dialogue, a think tank that tracks disinformation and extremism. The API has been invaluable to Wildon's research, he says, but "there are obvious risks with it. It can be abused." At the start of the war, for instance, he and another researcher found that it was possible to spoof Telegram's locations API to pinpoint any user within a 2-mile radius if they had recently turned on their location. Countless users were "accidentally setting [themselves] as a homing beacon," Wildon says. He was able to locate four people near Chernobyl with an accuracy of 1 yard just as Russian forces were trying to seize the area. Telegram disputes this level of accuracy, but shortly after Wildon's research partner went public with their methods, Telegram quietly altered its code. But Wildon has found it's still possible to locate other users with an accuracy of around 600 yards.

Although it would make his research more difficult, Wildon believes accessing data about Telegram's users should be as "hard as possible." Currently, he says, "with enough willpower, decent servers, and enough API keys, you could archive nearly the lot of Telegram"—every one of the hundreds of billions of texts, audio files, and images shared publicly on the platform.

AS SOON AS THE WAR BEGAN, CYBERSECURITY EXPERTS BEGAN RAISING CONCERNS ABOUT TELEGRAM USERS' EXPOSURE TO RUSSIAN AUTHORITIES—EVEN USERS WHO ARE OUTSIDE RUSSIA.

Indeed, some private companies *have* archived significant swaths of Telegram. TGStat, for instance, is a Russian firm that provides metrics about Telegram channel and user growth in different countries. In its privacy policy, TGStat states clearly that it is obliged by law to hand over data to the "state authorities of the Russian Federation." Because the company has been archiving publicly available data for years, Wildon says, security forces could hypothetically go directly to TGStat to obtain a striking amount of information about a user without any direct assistance from Telegram. Data such as a user's telephone number and the groups they are members of could be reverse engineered by aggregating the member lists of many groups or chat histories. "If you can identify a single user and have enough chats on record," says Wildon, "it's also possible to generate a file containing every message a user has sent into any group."

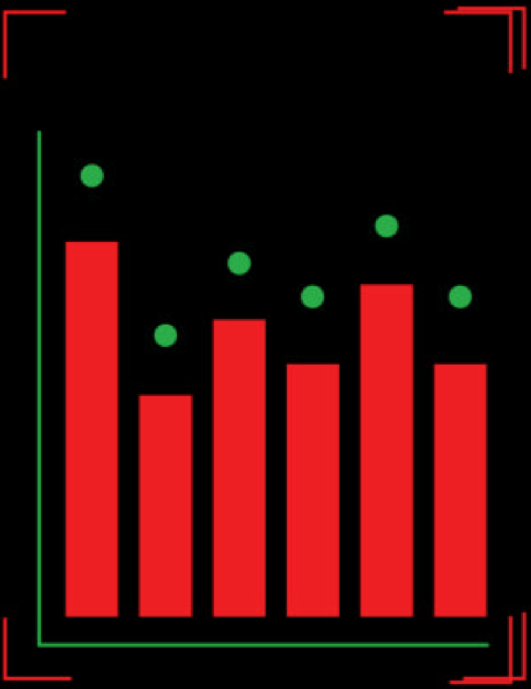
In an email to WIRED, TGStat founder Yury Kizhikin wrote, "The situation in Russia and the world has no influence on the activities of TGStat." He confirmed that data can be transferred to Russian authorities but said that "all companies operating in Russia have a similar clause in their policies" and that TGStat had not received any requests from authorities or law enforcement agencies.

Stanislav Seleznev, a lawyer for Agora, a human rights group that has represented thousands of people who've come under Kremlin scrutiny since 2005, says he has "absolutely no doubt" the Kremlin is exploiting Telegram's API at scale. Russia has spent lavishly to track its citizens on Telegram and other platforms. In September 2021, Reuters reported that the Kremlin was projected to spend $425 million on tools to bolster its internet infrastructure, including those that automatically search for illegal content on social media platforms. Seleznev says the Kremlin is also working with Russian tech firms like SeusLab, which processes a billion social networking pages and instant messaging chats a day, to produce detailed profiles of users based on their "political activity." SeusLab director Evgeny Rabchevsky told Reuters that "authorities use the product to assess social tensions, identify problematic issues of interest [and] adjust their activities."

A burgeoning pro-war open source intelligence community has also built an army of bots on Telegram to search for users via username and see which public groups they're in and which channels they follow, making them easier to identify. According to Ksenia Ermoshina, a researcher at Citizen Lab and the Center for Internet and Society, people who know how to navigate the system can get a fairly detailed portrait of a user's public activities just by entering their Telegram ID, "which is quite scary."

According to a report in Reuters, one member of that open source intel community is a pro-Putin NGO called the Center for the Study and Network Monitoring of the Youth Environment, which has developed an AI tool to scan social media for what it describes as socially dangerous content. The system, founder Denis Zavarzin has said, is "constantly monitoring" about 1.5 million accounts.

But those tools, however powerful, can peer only into Telegram's public chats and channels. To access private chats like Marina Matsapulina's exchange with her friends the day the SWAT team banged down her door—let alone end-to-end encrypted "secret chats"—Telegram's API is not enough. To reach into those chats, the Kremlin seems to have found other methods and, perhaps, other accomplices.



On March 4, 2022, the day before the police detained Matsapulina for "terrorism," Vladimir Putin signed into law a bill that introduced prodigious jail terms and fines for anyone who published "knowingly false information" about the Russian military. In effect, anyone criticizing the war in Ukraine on social media could face up to 15 years in prison. The law quickly became the basis for a mounting series of arrests and prosecutions. When Telegram emerged as one of the last remaining oases of information and discussion for Russians, it also became a kind of funnel for Kremlin agents. Agora's Seleznev believes that Telegram's API allows investigators to monitor public groups at a large scale and then zero in on potential suspects, who can subsequently be pursued into private channels by undercover agents—or perhaps via a court order to Telegram.

In early April, a music producer and bus driver in Russia named Richard Rose posted a video on Instagram that accused Russian troops of murdering hundreds of Ukrainian civilians in Bucha—an event that has been internationally condemned as a massacre. According to the independent Russian outlet Meduza, the video quickly gained the attention of an FSB officer in Rose's home city of Kirov. In the days that followed, Rose also sent messages on Telegram asking about ways to help Ukrainian soldiers. Rose suspects that, at times, he was communicating with FSB officers. In a written message to WIRED through his lawyer, Rose says his suspicions escalated when these interlocutors began to persuade him to take certain actions. "I regarded this as an inducement to commit a terrorist act," Rose says.

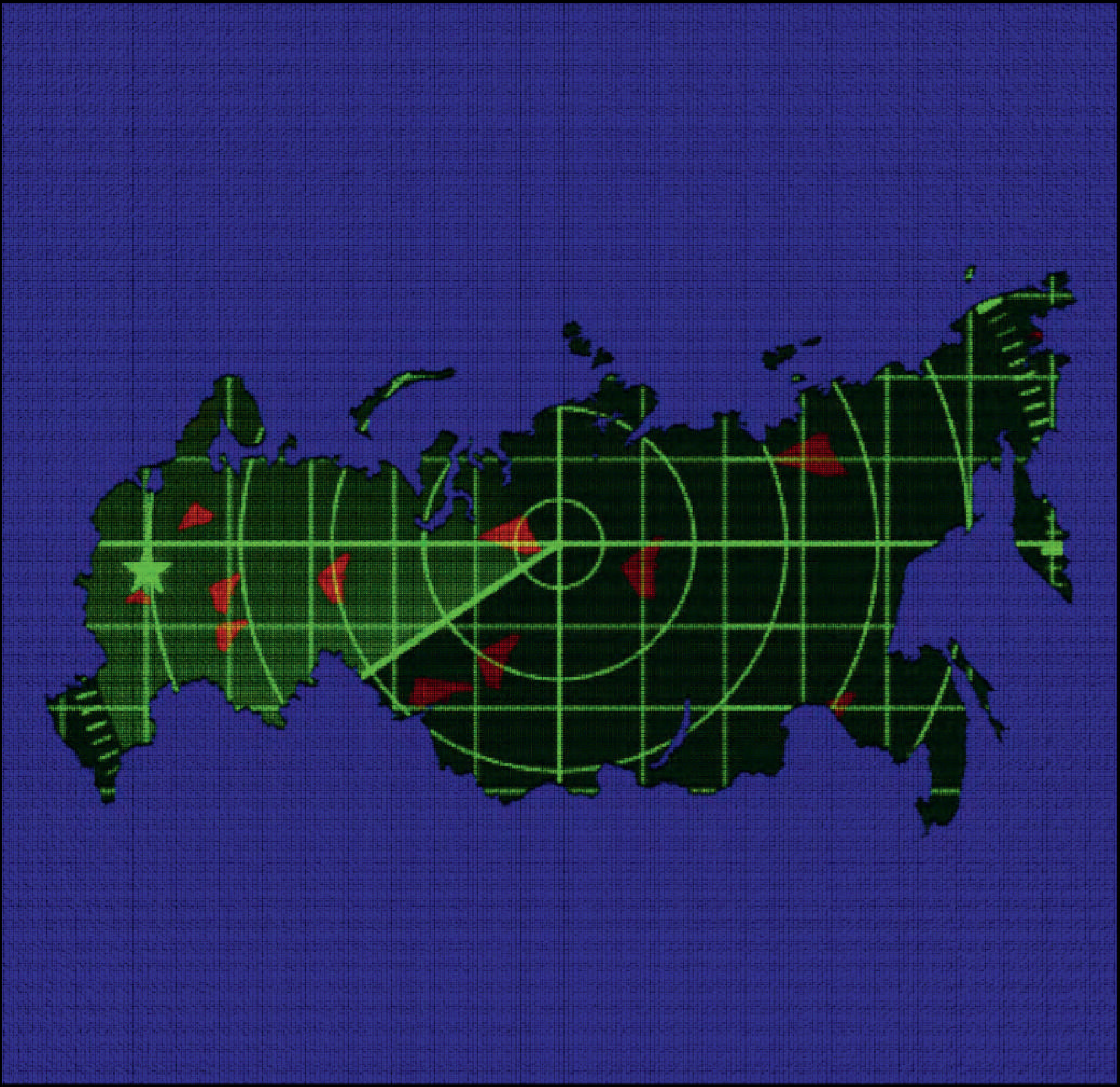
Agora believes that police infiltration of Telegram is widespread. In neighboring Belarus, security services work from a manual that describes "tools and methods" for "deanonymizing" users on Telegram, including tips for infiltrating groups. Ermoshina suspects that much the same is happening in Russia, judging from the uptick in criminal cases that cite a suspect's Telegram activity—a development she blames partly on the platform. "Telegram could have become a place where Russian authorities are not welcome," she says. A Telegram spokesperson writes, "Like ordinary users, representatives of police organizations around the world are likely to use every available internet service for communication. Telegram is not aware of any cases where we could have influenced their choices."

On April 13, the FSB secured a court order to monitor Rose's phone calls and read his messages. It's unclear whether Telegram complied with that order. The next day, Rose and his wife, who had also posted the video about Bucha, were arrested on charges of spreading "knowingly false information," with investigators citing Telegram messages Rose had sent to an unknown person with a Latvian phone number in which he asked about evacuating his family from Russia. While in pretrial detention, Rose learned that Russian authorities had labeled him an "extremist."

As Meduza reported, it's unclear whether investigators accessed Rose's messages before or after they arrested him. A Telegram spokesperson told WIRED that the company has never shared user information or messages with the FSB or the Kremlin. It's possible that Rose's Latvian interlocutor was an undercover agent or that investigators physically accessed Rose's messages when he was forced to give up his phone during interrogation. (According to recent reporting from the Israeli newspaper *Haaretz*, Russian authorities possess software that allows them to get around passcodes on locked phones.)

Even more mystery surrounds some ghostly activity that dissidents have encountered in Telegram's most secure settings. The platform claims its end-to-end encrypted "secret chats" feature (from which messages cannot be forwarded) is "safe for as long as your device is safe in your pocket." But in early May, the opposition activist Ania Kurbatova realized that both her regular messages and secret chats were showing up as "read" when she knew the recipient had not read them. She also noticed at times that when she logged out of a secret chat, the session would still be marked "open" and messages could still be read. This should have been impossible: Each chat receives a unique encryption key that disappears once a session is over. To continue the conversation, users need to start a new chat and receive a new encryption key. The private conversations, Kurbatova says, included one with "a Ukrainian journalist who was looking for information about people who were taken to Russia from the filtration camps from the Donetsk and Luhansk region." There was also "an important chat" with Kurbatova's partner, Ivan Astashin, an activist who in 2009 was sentenced to 10 years in prison for throwing a Molotov cocktail at an FSB office. Kurbatova says Astashin noticed the same oddities in his own secret chats.

Kurbatova and Astashin sought help from Ermoshina, who asked them to check the app's "active sessions" feature, which shows the other devices they have the app open in. Nothing turned up. Then she had them reinstall the app. Even after



these precautions, secret chats continued to show as read, and old sessions could still be reopened.

Ermoshina was at a loss for a technical explanation but noted that, as a well-known activist couple, Kurbatova and Astashin are a valuable target for the Kremlin. And their case isn't isolated. In August, Yana Teplitskaya, a human rights activist who has investigated the alleged torture of Russian prisoners, noticed that many of her secret chats were erroneously marked as read.

While it's possible spyware was involved, such cases have turned dissidents' suspicions to Telegram itself. For many activists, this represents a precipitous loss of faith.

WHAT HAPPENED to Marina Matsapulina in her apartment eerily mirrors something that once happened to Pavel Durov—an event that serves as the founding myth of Telegram. In December 2011, in the wake of a highly controversial round of parliamentary elections, Durov, then the 27-year-old CEO of VKontakte, received a request from the FSB to take down the pages of opposition groups. Durov refused, then theatrically taunted the government on Twitter. As he later told *The New York Times*, a SWAT team soon arrived at his apartment. As they pounded on his door, Durov called his older brother but quickly realized he had no secure means of communication. In that moment, Durov claimed, he saw the need for a platform that could skirt authoritarian surveillance. "That's how Telegram started."

For more than a decade, "Russia's Mark Zuckerberg" has taken pains to maintain a larger-than-life persona as a brash, black-clad, libertarian crusader against authoritarian surveillance, whose primary foil has been the Russian state. But as Matsapulina suggested in her Twitter thread last April, Telegram's relationship with the Russian state seems to have changed markedly over the past few years.

As she reminded her followers,

relations between the platform and authorities were at a low point in 2018. That April, Durov refused an order from the FSB to hand over the encryption keys of Russian users. In response, the Kremlin banned Telegram from Russia, and telecom regulator Roskomnadzor set about blocking access to Telegram from the Russian internet.

Thousands of people protested the decision in Saint Petersburg, some brandishing posters that depicted Durov as a glowing religious icon holding Telegram's paper-plane logo. Adding to the defiant-hero narrative, Durov's staff hid Telegram behind Google's and Amazon's hosting services to disguise and constantly change its web addresses. In a brief bit of collateral damage, Roskomnadzor accidentally blocked some 16 million IP addresses in Russia, including much of Twitter and Facebook. Telegram, for most users, kept running.

But in June 2020, Russia and Telegram suddenly reached a deal to unblock the app, the exact terms of which remain undisclosed despite requests for transparency from cybersecurity researchers, journalists, and human rights groups. Most Russians, Matsapulina noted in her thread, laughed off the possibility that Telegram had made any concessions to the Kremlin. But when Russian authorities announced the deal, she wrote, they "literally stated" that the two sides had reached it "in the context of terrorism," the very context invoked in the arrest of Matsapulina and others.

In fact, the fuller story surrounding Telegram's ban and reinstatement does raise the question of whether Moscow has gained some leverage over Durov.

Back in 2018, while playing cat and mouse with Roskomnadzor, Telegram was also working to develop something it had always lacked: a means of making money. As the platform had never hosted ads or offered subscriptions, the company set out to build an entire economy on top of Telegram, creating the Telegram Open Network, or TON, a blockchain platform with its own cryptocurrency, called grams, that would be integrated into the main app. Like many blockchain startups, it would raise money through an initial coin offering, allowing investors to buy grams. Ambitions were high: Two weeks before Roskomnadzor blocked the app, Telegram announced that the ICO had raised $1.7 billion, the largest in history at the time. (Much of the investment, as independent Russian media reported, came from oligarchs, including a rumored $300 million from key Putin ally Roman Abramovich.)

But in 2019, disaster struck. Just as TON was set to launch, the US Securities and Exchange Commission charged Telegram with illegally failing to register the cryptocurrency and claimed the company had appropriated funds designated for TON to pay its bills. Durov fought the SEC's emergency action for a year but bitterly announced the end of TON in May 2020.

Forced to pay back investors and saddled with Telegram's soaring server costs, Durov needed a massive influx of cash. At that moment, Telegram's relationship with Russia began to thaw. A few weeks after the TON project ended, two pro-Kremlin party deputies in Russia's parliament proposed that the ban on Telegram be lifted, arguing that it could be an important communications tool for the government in times of crisis. Durov posted his support of their proposal on Telegram, arguing that the company's presence in Russia could help bolster the country's technological

innovation and “national security.” He also claimed that, since 2018, his team had improved “methods for detecting and removing extremist propaganda” as well as “mechanisms that allow preventing terrorist attacks around the world” while still protecting user privacy. He didn’t elaborate on how this was possible.

On June 18, Roskomnadzor lifted the ban. To Western users and media at the time, the détente seemed to show that Durov’s antiauthoritarian cunning had prevailed. Telegram, one expert told *The Washington Post*, “seems to have won a staring contest with Putin and the security state.”

But who actually blinked? What terms had Telegram and Roskomnadzor agreed to? Both sides offered sparse explanations.

In a statement, the regulator praised Durov’s new, helpful attitude: “We commend the readiness expressed by Telegram’s founder to combat terrorism and extremism.” Unnamed government sources told the Russian news agency Interfax that Telegram had agreed to cooperate with security services in specific cases. Those sources also noted that technological developments had rendered the need for encryption keys “irrelevant” but didn’t explain further. In a Telegram post after the decision, Durov assured Russian users there’d be “no changes in terms of the safety of personal data.” Putin himself celebrated the announcement on live TV a year later during his annual Direct Line Q&A. “We have reached an agreement with Telegram,” he said. “You can see that everything is working fine.”

KURBATOVA REALIZED HER SECRET CHATS WERE SHOWING TO HER AS “READ” WHEN SHE KNEW THE RECIPIENT HAD NOT ACTUALLY READ THEM. THIS SHOULD HAVE BEEN IMPOSSIBLE.

According to a government source familiar with the deal, the Russian state-owned bank VTB, which has close ties with the Kremlin, was also involved in the negotiations. In January 2021, reporting came out that Telegram had hired VTB to estimate the company’s value: as high as $124 billion by 2022. Telegram also said it would start selling five-year bonds. VTB would help shop them around to investors. By March 2021, Telegram had raised more than $1 billion from these backers. Although little is known about their identities—Durov wrote on his Telegram channel only that they were “some of the largest and most knowledgeable investors all over the world”—*The Moscow Times* reported that the investments included $75 million from a joint partnership between an Abu Dhabi state fund and a Kremlin sovereign wealth fund. When WIRED asked about the terms of the agreement, a Telegram spokesperson wrote: “We can confirm that no deals were made to inspire the unblocking of Telegram. That decision was made solely by the authorities in Russia.” (VTB did not respond to requests for comment.)

Three weeks after the deal to unblock Telegram, the company’s vice president, Ilya Perekopsky, appeared at a conference outside Kazan to talk about growing Russia’s IT industry and joined prime minister Mikhail Mishustin in a pledge to fight the dominance of American tech. Introducing a speech by Perekopsky in which he noted Telegram’s “Russian roots,” deputy prime minister Dmitry Chernyshenko also stated that it was “great news” that Telegram was operating in Russia once more. Human rights groups, opposition activists, and independent Russia media found this sudden harmony between once bitter foes as fascinating as it was concerning. Several noted the fortuitous timing.

Since Russia’s invasion of Ukraine, Telegram and the Kremlin have appeared even more in sync. Allowed to remain standing in a decimated internet sector, Telegram has become useful not only to security services but also to the state’s propaganda machine. Blanket censorship of Russian media has made Telegram a vital source of information for Russians, with Meduza and other outlets sharing reports via public channels on the platform. But pro-Kremlin disinformation far outpaces journalism. “Telegram now is the central backbone for Russian disinformation machinery,” says Jānis Sārts, director of the NATO Strategic Communications Centre of Excellence. “It’s also the way they overcome all the roadblocks built by Western platforms.” Two weeks before Facebook was banned, a post on the Russian government’s Telegram channel summarized a meeting between deputy prime minister Dmitry Chernyshenko and IT industry leaders in which Chernyshenko stated that “government agencies are recommended to create accounts on Telegram and VKontakte.” Telegram is now the platform of choice for Kremlin officials.

The relationship between Telegram and VTB has also grown: A few months after the invasion began and Apple and Google had removed VTB’s app from their stores, the company announced it was launching a digital bank on Telegram “to overcome restriction of sanctions for customers.”

In addition to Roskomnadzor’s press office, WIRED contacted three current and former employees from the regulator about the deal, as well as one current and one former government minister thought to be familiar with it. None agreed to speak. WIRED messaged, via Telegram, the deputy head of Roskomnadzor, Vadim Subbotin, about the 2020 deal; he said to direct questions to the regulator’s press office, and then deleted the chat history. Vadim Ampelonsky, a former spokesperson for the regulator, responded, “I am a *vatnik*”—literally a quilted jacket, slang denoting a devout follower of government propaganda. He added that “in the current situation, participating in research for an American publication is *zapadlo*”—vulgar slang that means beneath one’s dignity. He signed off: “Take care of yourself!”

AT THE END of Matsapulina’s April 2022 Twitter thread, she said that she and her colleagues had moved from Telegram to Signal. “I don’t want to spread panic, I don’t want to pretend I’m some kind of expert on this issue, but I want to urge everyone to be careful what they say on Telegram. It is possible that this is no longer the safe space everyone used to think it was.”

According to Ksenia Ermoshina, much of the Russian opposition movement has likewise abandoned Telegram. To widespread dismay, she says, pro-war channels started posting activists’ personal information with impunity—“compiling databases of Russian anti-war activists with their faces and links to their [social media], and sometimes even home addresses and other personal data.” When users reported these incidents, she says, Telegram’s response was slow or nonexistent.

Many chats and groups where users organized opposition movements have been shut down. “No one has organized anything on Telegram since February,” Ermoshina says, describing a “digital migration” of Russia’s opposition movement from Telegram. “People moved out of Russia in exile,” she says, “and they moved out of Telegram in exile!”

ERMOSHINA DESCRIBES A “DIGITAL MIGRATION” OF THE OPPOSITION MOVEMENT. “PEOPLE MOVED OUT OF RUSSIA IN EXILE, AND THEY MOVED OUT OF TELEGRAM IN EXILE!”

Natalia Krapiva, a lawyer at the digital rights group Access Now, notes that Telegram has never responded to requests for clarity, including an open letter sent by her organization and a coalition of groups asking for dialog on “safety and security issues plaguing” the app. Regarding concerns that the platform is facilitating state surveillance, she says, “Telegram hasn’t done much to demonstrate that, in fact, they’re not cooperating” with the authorities.

Meanwhile, cases of Telegram cooperating with governments outside Russia have emerged. In January 2022, after Telegram ignored multiple requests from German authorities to stanch a wave of violent anti-Covid-lockdown protests that had been coordinated on the platform, the German government debated banning it. By June, *Der Spiegel* reported, Telegram had provided German federal police with personal data of users suspected of terrorism and child abuse. And in India, where there are more than 100 million Telegram users, the company in November provided the Delhi High Court with the names, phone numbers, and IP addresses of users accused of illegally sharing a teachers' copyrighted course materials on the platform.

Pavel Durov has not given an interview to Western media since 2017. He declined to speak on the record for this story. But in a video call last fall, one of Durov's associates offered insights into the mindset of Telegram's founder. Georgy Lobushkin used to be VK's head of PR and remains in contact with his old boss, having attended Durov's 38th birthday in Dubai in October. He often posts unofficial information about goings-on at the company on his Telegram channel: "Sometimes in Russia people call me the gray cardinal of Telegram because I say things on behalf of Telegram, but I'm not formally part of the team."

"The Russian market is very important to Durov," Lobushkin said, noting that it represents about 7 percent of Telegram's 700 million users, not to mention its symbolic importance. Sure, Durov has said he will never cooperate with Russian authorities and would leave the market if push came to shove, Lobushkin says, but that might be "a bluff" since Russia holds such a significant percentage of the platform's users.

Lobushkin says he has no special information about why Telegram was unblocked in 2020. But he believes the Kremlin saw potential in the platform. "The Russian propaganda machine learned how to use Telegram effectively and efficiently," Lobushkin says.

Pavel Cherkashin, a Russian-born venture capitalist based in San Francisco who invested in the TON project before its collapse, argues that Durov is comfortable operating in a gray zone—willing to turn a blind eye to the Kremlin because the relationship is good for growth. "Putin becomes a great ally for developing his business, and he accepts this as a serendipity," Cherkashin says. He adds that because Putin controls which platforms can operate in Russia, "he's forcing all of the business—all of that is now on Telegram."

It's true that a huge number of Russians continue to depend on Telegram, and its growth in the country and globally has been spurred by the war in Ukraine rather than deterred—even *The New York Times* opened a Telegram channel to disseminate news about the war. "People still trust Telegram for some reason," says Andrei Soldatov, an independent journalist who has investigated Russian security services for more than 20 years. "But I don't know why."

In late April 2022, three days after posting her thread, Matsapulina received an anonymous message through Telegram's official support account. She later took to Twitter to recount the exchange. "We read your story on Twitter," it began. "We'd like to express our sympathy with your case and share the results of an investigation our team did." The message said that only two authenticated devices had access to her Telegram messages: her phone and her computer. It also noted a failed login attempt "after your detention." Someone, whom Matsapulina presumed to be a police officer, had correctly entered an SMS verification code but incorrectly entered her password. "From Telegram's side, access to your private messages has not been granted." The message concluded that, most likely, someone had taken physical possession of her device—which seemed highly improbable to her, given the short time between her arrest and when her messages were recited back to her—or her friends in the group chat had been compromised.

Matsapulina and her friends then asked Telegram to check their logs. She says the company reported that they hadn't been compromised either. This left Matsapulina back where she began: How did the officers read her messages?

After discussing her case with experts, Matsapulina now believes her Telegram messages may have been compromised by a form of spyware. When she was told that a hacking device would need to be physically nearby to infiltrate her phone, a memory resurfaced: At times before her arrest, she had noticed an unmarked truck with a dome on its roof parked outside her building. She had even jokingly mentioned it to friends on Telegram. Now, she remembered, as the police were banging on her door that morning, she'd spotted the same mystery vehicle parked outside. By the time the police stormed her home, the vehicle was gone.

Matsapulina has since started using Telegram again. For one, she says, even if Russian security services were tracking her account, she has already left the country. It's also her only way of reaching friends and family: For Matsapulina and millions of Russians alike, the cipher of a platform remains indispensable.

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DEPTH CHARGE

Companies are gearing up to MINE the SEAFLOOR, targeting rocks rich with metals that are essential to

our EV-powered future. THE BIG QUESTION: How much OCEAN are we willing to SACRIFICE?

by VINCE BEISER photograph by ANDRIA LO

In October of last year, an enormous new creature appeared on the seabed of the Pacific Ocean, about 1,400 miles southwest of San Diego. It was a remote-controlled, 90-ton machine the size of a small house, lowered from an industrial ship on a cable nearly 3 miles long. Once it was settled on the ocean floor, the black, white, and Tonka-truck-yellow contraption began grinding its way forward, its lights lancing through the darkness, steel treads biting into the silt. A battery of water jets mounted on its front end blasted away at the seafloor, stirring up billowing clouds of muck and dislodging hundreds of fist-sized black rocks that lay half-buried in the sediment.

The jets propelled the lumpy stones into an intake at the front of the vehicle, where they rattled into a steel pipe rising all the way back up to the ship. Air compressors pushed the rocks up in a column of seawater and sediment and into a shipboard centrifuge that spun away most of the water. Conveyor belts then carried the rocks to a metal ramp that dropped them with a clatter into the ship's hold. From a windowless control room nearby, a team of engineers in blue and orange coveralls monitored the operation, their faces lit by the polychromatic glow from a hodgepodge of screens.

The ship, called the *Hidden Gem*, was a former oil-drilling vessel nearly 800 feet long, retrofitted for sea mining by the Metals Company, an international firm officially headquartered in Canada. This was the first test of its system to collect the ancient black stones. They are officially known as polymetallic nodules, but the Metals Company's CEO, Gerard Barron, likes to call them "batteries in a rock." That's because the stones happen to be packed with metals that are essential for manufacturing electric cars—a market that is surging worldwide. Barron's company is at the front of a pack of more than a dozen enterprises slavering over the billions of dollars that could be reaped from those little subsea rocks.

The world's long-overdue, fitful transition to renewable energy is hobbled by an Achilles' heel: It requires staggering quantities of natural resources. Manufacturing enough electric vehicles to replace their fossil-fueled counterparts will require billions of tons of cobalt, lithium, copper, and other metals. To meet the exploding demand, mining companies, carmakers, and governments are scouring the planet for potential mines or expanding existing ones, from the deserts of Chile to the rain forests of Indonesia. Meanwhile, what might be the richest source of all—the ocean floor—remains untapped. The US Geological Survey estimates that

21 billion tons of polymetallic nodules lie in a single region of the Pacific, containing more of some metals (such as nickel and cobalt) than can be found in all the world's dry-land deposits.

"Here's one of them," Barron said when we met recently in the lobby of a chic Toronto hotel, as he casually pulled one of these geologic oddities out of his jacket pocket and handed it to me. Barron is a fit, muscular Australian in his mid-fifties, with swept-back dark hair, a nautical beard, and craggy Kurt Russell–esque looks. His jeans, black boots, and wristloads of leather bracelets lend him a roguish air. He has just flown in from London for a big mining conference. For years, he's been traveling the world to talk up deep-sea mining to investors and government officials. He and other would-be sea miners argue that collecting nodules from the deep will be not only cheaper than traditional mining but also gentler on the planet. No rain forests uprooted, no Indigenous peoples displaced, no toxic tailings poisoning rivers.

Barron may finally be on the brink of achieving his goal of mega-scale mining on the ocean floor. The Metals Company has tens of millions of dollars in the bank and partnerships with major maritime companies. The *Hidden Gem*'s foray last October marked the first time since the 1970s that any company had successfully trialed a complete system for harvesting nodules.

The main thing holding the company back is international law, which currently forbids deep-ocean mining. That may be about to change, however. Last year, the Metals Company teamed up with the tiny South Pacific island nation of Nauru to trigger an obscure process that could let them bypass the international prohibition and get a license to start full-scale operations as early as July 2024.

That prospect has sparked an outraged backlash. Environmental groups, scientists, and even some corporations in the market for battery metals fear the potential havoc of seabed mining. The oceans provide much of the world's biodiversity, a significant chunk of humanity's food, and the planet's biggest carbon sink. No one knows how such an unprecedented incursion would affect the many life-forms that live in the abyssal depths, the marine life farther up the water column, or the ocean itself. The European Parliament and countries including Germany, Chile, Spain, and several Pacific island nations have joined dozens of organizations in calling for at least a temporary moratorium on deep-sea mining. Several banks have declared they won't loan to ocean-mining ventures. Corporations including BMW, Microsoft, Google, Volvo, and Volkswagen have pledged not to buy deep-sea metals until the environmental impacts are better understood. Even Aquaman is opposed: Jason Momoa narrated a recently released documentary denouncing sea mining.

"This has the potential to transform the oceans, and not for the better," says Diva Amon, a marine scientist who has worked extensively in the main area of the Pacific targeted for mining, including as a contractor for one of the sea-mining companies. "We could stand to lose parts of the planet and species that live there before we know, understand, and value them."

None of that deters Barron. "The biggest challenge to our planet is climate change and biodiversity loss. We don't have a spare decade to sit around," he declares. By the end of the *Hidden Gem*'s trial last October, the vehicle had delivered more than 3,000 tons of the stones, mounded up in a glistening black pyramid nearly four stories high. "This," Barron promised the press, "is just the beginning."

THE NODULES HAVE been growing, in utter blackness and near-total silence, for millions of years. Each one started as a fragment of something else—a tiny fossil, a scrap of basalt, a shark's tooth—that drifted down to the plain at the very bottom of the ocean. In the lugubrious unfolding of geologic time, specks of waterborne nickel, copper, cobalt, and manganese slowly accreted onto them. By now, trillions lie half-buried in the sediment carpeting the ocean floor.

One March day in 1873, some of these subaqueous artifacts were dragged for the first time into sunlight. Sailors aboard the HMS *Challenger*, a former British warship retrofitted into a floating research lab, dredged a net along the sea bottom, hauled it up, and dumped the dripping sediment onto the wooden deck. As the expedition's scientists, in long trousers and shirtsleeves, eagerly sifted through the mud and muck, they noted the many "peculiar black oval bodies" that they soon determined were concretions of valuable minerals. A fascinating discovery, but it would be almost a century before the world began to dream of exploiting these stones.

In 1965, an American geologist published an influential book called *The Mineral Resources of the Sea,* which

The Metals Company uses a former oil-drilling vessel, the *Hidden Gem*, to collect polymetallic nodules from the seafloor.

generously estimated that the nodules contained enough manganese, cobalt, nickel, and other metals to feed the world's industrial needs for thousands of years. Mining the nodules, he speculated, "could serve to remove one of the historic causes of war between nations, supplies of raw materials for expanding populations. Of course it might produce the opposite effect also, that of fomenting inane squabbles over who owns which areas of the ocean floor."

In an era when population growth and an embryonic environmental movement were fueling concerns about natural resources, seabed mining suddenly got hot. Throughout the 1970s, governments and private companies rushed to develop ships and rigs to pull up nodules. There was so much hype that in 1972, it seemed completely plausible when billionaire Howard Hughes announced that he was dispatching a custom-built ship into the Pacific to search for nodules. (In fact, the CIA had recruited Hughes to provide cover for the ship's Bond-esque mission: to covertly retrieve a sunken Soviet submarine.) But none of the actual sea miners managed to come up with a system that could do the job at a price that made sense, and the fizz went out of the nascent industry.

CORALS, SPONGES, and NEMATODES live on the rocks or shelter beneath them. Other CRITTERS float around them, including ANEMONES with 8-FOOT TENTACLES.

By the turn of the 21st century, advancing marine technology made sea mining seem plausible again. With GPS and sophisticated motors, ships could float above precisely chosen points on the seafloor. Remotely operated underwater vehicles grew more capable and dove deeper. The nodules now seemed to be within reach, just at the moment when booming economies such as China's were ravenous for metals.

Barron saw the potential bonanza decades ago. He grew up on a dairy farm, the youngest of five kids. (He now has five of his own.) "I knew I didn't want to be a dairy farmer, but I loved dairy farm life," he says. "I loved driving tractors and harvesters." He left home to go to a regional university and started his first company, a loan-refinancing operation, while still a student. After graduating, he moved to Brisbane "to discover the big, wide world." Over the years, he has been involved in magazine publishing, ad software, and conventional car battery operations in China.

In 2001, a tennis buddy of Barron's—a geologist, former prospector, and early web-hosting entrepreneur named David Heydon—pitched him on a company he was spinning up, a sea-mining outfit called Nautilus Minerals. Barron was fascinated to learn that the oceans were filled with metals. He put some of his own money into the venture and rounded up other investors.

Nautilus wasn't going after polymetallic nodules, but rather what seemed like an easier target: underwater formations called seafloor massive sulfides, which are rich in copper and other metals. The company struck a deal with the government of Papua New Guinea to mine sulfides off the country's coast. (Under international law, countries can do basically whatever they want within their Economic Exclusion Zones, which extend up to 200 miles from their coastlines.) It sounded good enough to attract half a billion dollars from investors, including Papua New Guinea itself.

But in 2019, after spending some $460 million, Nautilus went bust. Neither Barron nor Heydon lost any of their own money: Both had sold their shares about a decade earlier, with Barron clearing about $30 million in profit. Papua New Guinea, where more than half the population lives in poverty, was out $120 million. "It wasn't my business," Barron tells me. "I was just supporting David, really."

Heydon, meanwhile, was building a company called DeepGreen—rebranded in 2021 as the Metals Company—this time pursuing polymetallic nodules. By then, the growing demand for electric vehicles had added both a new potential market and an extra environmental justification for the project. Barron came on as CEO, and several other Nautilus alums joined up, including Heydon's son Robert. Along with other would-be miners, they started knocking on the door of the International Seabed Authority.

Based in Kingston, Jamaica, the ISA has the contradictory tasks of protecting the ocean floor while organizing its commercial exploitation. Back in the 1980s, most of the world's nations—notably excluding the United States—signed a kind of constitution for the oceans, the United Nations Convention on the Law of the Sea. Among many other things, the document established the International Seabed Authority to represent what are now its 167 member nations. The organization was charged with devising rules to govern the then-nonexistent deep-sea-mining industry. The testudinal pace of subsea geology is rivaled only by that

TMC PHOTOGRAPHS COURTESY OF RICHARD BARON/TMC

of international bureaucracy, and the ISA has been working to develop those rules ever since. Until regulations are agreed upon, full-scale mining is prohibited. But in the meantime, the agency can grant miners the rights to explore specific areas and reserve them for commercial exploitation. The ISA also declared that private companies must partner with a member country. Even the tiniest member country will do.

By now, the Seabed Authority has granted permits to 22 companies and governments to explore enormous swaths of the Pacific, Atlantic, and Indian Ocean seabeds. Most are targeting nodules lying roughly 3 miles underwater in the Clarion Clipperton Zone, an expanse of the Pacific between Mexico and Hawaii measuring 1.7 million square miles. Holding the rights to three of the choicest parcels is Gerard Barron and the Metals Company. The company's chief financial officer recently told investors that those expanses could yield metals worth $31 billion.

Here's what makes all of this urgent. The mining ban has a loophole: the two-year trigger. A section of the treaty known as Paragraph 15 states that if any member country formally notifies the Seabed Authority that it wants to start sea mining in international waters, the organization will have two years to adopt full regulations. If it fails to do so, the treaty says the ISA "shall none the less consider and provisionally approve such plan of work." This text is commonly interpreted to mean mining must be allowed to go ahead, even in the absence of full regulations. "Paragraph 15 was appallingly drafted," says Duncan Currie, a lawyer for the Deep Sea Conservation Coalition, an international umbrella organization of dozens of groups. "Several countries dispute the idea that it means they need to automatically approve a plan of work."

In the summer of 2021, the president of Nauru formally notified the Seabed Authority that the country, along with the Metals Company's wholly owned subsidiary, Nauru Ocean Resources, planned to begin sea mining. The two-year trigger has been pulled. The Metals Company's audacious gambit may have opened the door to deep-sea mining for the first time.

"AS AN ENVIRONMENTALIST," Barron says, he finds the opposition to his plans frustrating. "'Save the oceans' is a really easy slogan to get behind. I'm behind it!" he says. "I want to save the oceans, but I also want to save the planet." It might be true that getting metals from the seafloor is less damaging than getting them from land. But so far, few outside the industry are convinced.

Very little is truly known about the deep ocean. Gathering data hundreds of miles from land and miles below the water's surface is extraordinarily difficult. A single day's work can cost up to $80,000, and sophisticated tools such as remotely operated vehicles have only recently become available to many scientists. In 2022, 31 marine researchers published a paper that reviewed hundreds of studies on deep-sea mining. The authors also interviewed 20 scientists, industry members, and policymakers; almost all said the scientific community needed at least five more years "to make evidence-based recommendations" for regulating the industry.

Every phase of the mining process entails serious risks for the world's oceans, which are already severely stressed by pollution, overfishing, and climate change. Start at the bottom. A massive piece of machinery tank-treading over the pristine ocean

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The nodule-collecting machine gets lowered to the ocean floor on a cable that's nearly 3 miles long. Onboard the ship, engineers in a control room monitor its progress.

floor, prying loose thousands of nodules from the beds where they have lain for millennia, is inevitably going to cause some damage. Corals, sponges, nematodes, and dozens of other organisms live on the nodules themselves or shelter beneath them. Other critters float around them, including anemones with 8-foot tentacles, rippling squidworms, glass sponges, and ghostly white Dumbo octopuses. "It's like Dr. Seuss down there," says Amon, the marine scientist. The nodules, Amon believes, are a critical part of the ecosystem that supports all those creatures. And since they formed over millions of years, any harm that results from removing them "is in effect irreversible." Some scientists are also concerned that the huge amounts of carbon embedded on the ocean floor could be released, potentially interfering with the ocean's ability to sequester carbon.

Silt and clay stirred up by the collector vehicles will also rise up into the water, creating plumes of sediment that could cloud the water for miles, linger for weeks or more, and suffocate creatures farther up the water column. Those plumes might also contain dissolved metals or other toxic substances that could harm aquatic life.

Moving upward, the noise and light emitted by the harvester vehicles and riser systems could affect any number of creatures that have evolved to live in silence and darkness. A recent study found that the racket from just one seabed mining operation could echo for hundreds of miles through the water, potentially interfering with aquatic organisms' ability to navigate and find food and mates.

Once the nodules have been carried up to a ship, the silt-infused water that accompanied them will have to be dumped back into the sea, creating another potentially dangerous sediment plume. "We are talking about massive volumes. Fifty thousand cubic meters a day," says Jeff Drazen, an ocean scientist at the University of Hawaii who has also worked extensively in the Clarion Clipperton Zone, including on a research mission funded by the Metals Company. "That's like a freight train of muddy seawater every day."

A 2022 report from the United Nations Environment Programme sums up the grim picture. Bottom line, according to the authors: "Current scientific consensus suggests that deep-sea mining will be highly damaging to ocean ecosystems." More than 700 marine science and policy experts have signed a petition calling for a "pause" on sea mining until more research has been conducted.

Barron insists that his company is committed to getting the science right and points out that it has funded 18 research expeditions (to fulfill the requirements of the Seabed Authority). "Last year I spent $50 million on ocean science," he tells me. "I don't see anyone else doing that."

By now, he argues, we know enough. "The lack of full scientific knowledge should not be used as an excuse not to proceed when the known impacts of the alternative—land-based mining—are there for us all to see," he says. It is a "certainty," he says, that sea mining will be less destructive. Whoever authored the Metals Company's own registration filing with the US Securities and Exchange Commission wasn't so categorical. That document notes that nodule collection in the Clarion Clipperton Zone is "certain to disturb wildlife" and "may impact ecosystem function" to an unpredictable extent. The filing adds that it may "not be possible to definitively say" whether nodule collection will do more or less harm to global biodiversity than land-based mining.

The Metals Company's critics say the company basically isn't interested in what the science shows. One environmental scientist quit a contract job with the company, complaining in a since-deleted LinkedIn post in 2020 that "the company has minimal respect for science, marine conservation, or society in general … Don't let them fool you. Money is the game. It's business in their eyes, not people or the planet." (Barron says this person is just a disgruntled ex-employee and that his charges aren't true. My efforts to contact the scientist were unsuccessful.)

THE METALS COMPANY is the only deep-sea mining outfit that is not backed by a major corporation or national government. It's a startup, wholly dependent at this point on fickle investor capital. That could certainly help explain why Barron seems to be in a hurry to start mining. When I ask him why the company triggered the two-year rule, he interrupts to clarify: "Well, Nauru did. We didn't. Nauru did."

You'd have a hard time finding a more extreme example of despoliation of a tropical paradise, of a fall from Eden, than Nauru. When the first European ship came across this 8-square-mile island in the South Pacific, in 1798, the captain was so charmed by the locals' friendly welcome, the fair weather, and the lovely beaches that he dubbed it Pleasant Island. But once an Australian geologist discovered that the spot was loaded with high-grade phosphate, much in demand as fertilizer, the outside world rushed in. Over the course of the 20th century, the nation of 12,000 people was strip-mined to the brink of oblivion. Its once-lush interior was reduced to what *The Guardian* described as a "moonscape of jagged limestone pinnacles unfit for agriculture or even building." As the phosphate began running low in the 1990s, Nauru tried to set itself up as a no-questions-asked offshore banking haven, but so much ill-gotten cash poured in that Nauru was forced to tighten its regulations. The island's next moneymaker was to rent some of its territory to Australia to use as an immigrant detention center. Detainees there have rioted, staged hunger strikes, and sewn their lips shut.

Given all that, it's easy to see the economic appeal of teaming up with the Metals Company—especially since the mining zone is nowhere near Nauru. "Our people, land, and resources were exploited to fuel the industrial revolution elsewhere, and we are now expected to bear the brunt of the destructive consequences of that industrial revolution," including sea-level rise, wrote Margo Deiye, Nauru's representative to the UN, in a December newspaper op-ed explaining why her country is supporting sea mining. "We're not sitting back, waiting for the rich world to fix what they created."

Barron, who has never set foot on the island, insists that the relationship is a respectful partnership, not a modern version of colonial exploitation. "It's horrible what happened to Nauru," he says. "They were absolutely fucked over by the Germans, the English, the Australians, and the Kiwis." The Metals Company says it has doled out more than $200,000 to support community programs of various sorts in Nauru, Kiribati, and Tonga, the two other island nations with which it has business arrangements. "The real contribution," he adds, "will be when we start paying royalties"—the partner nations' yet-to-be-decided percentage of mining revenues.

The Metals Company's own finances, however, are a bit shaky. Barron took the company public in September 2021, a few months after the two-year rule was triggered, claiming it had commitments of $300 million from investors. Its stock topped $12 per share a few days after it hit the market. But two key investors never delivered, leaving Barron and his team with only a third of their expected capital. The stock price plummeted and has remained stuck at around $1 for months. The company is suing the faithless investors and is being sued itself by other investors who claim they were misled. Meanwhile, it has burned through $300 million. A substantial chunk of that cash wound up in Barron's pocket. He and his partner, Erika Ilves, a former executive at a company aiming to mine water on the moon whom Barron brought on as chief strategy officer, were together paid more than $20 million in salary and stock options in 2021.

Bloomberg reporters and some environmental organizations have suggested that the company holds unfair leverage over its partner nations, and critics have drawn attention to the seemingly cozy ties between the Metals Company and the International Seabed Authority—in particular its secretary general, Michael Lodge. A recent *New York Times* investigation alleged that the ISA gave the company's executives access to data indicating where the most valuable seabed tracts were located, then helped it secure the rights to those areas. Both the agency and the company say that all their dealings have been legal and appropriate. (Lodge also made his stance on environmentalists pretty clear, telling the *Times*: "Everybody in Brooklyn can say, 'I don't want to harm the ocean.' But they sure want their Teslas.")

Between Barron's outspokenness and his company's legal and financial pyrotechnics, the Metals Company has drawn most of the media coverage around sea mining. "TMC is very bold, but the other companies are piggybacking on them," says Jessica Battle, who heads the World Wildlife Fund's campaign against sea mining. "Once one mining license is given, others will follow." There's an eager lineup. Belgian maritime giant Deme, high-tech hardware colossus Lockheed Martin, ship-builder Keppel Offshore & Marine, and the governments of South Korea, India, Japan, Russia, and China have launched dozens of research expeditions in recent years. China has two outfits licensed to explore for polymetallic nodules in the Pacific.

Deme's sea-mining subsidiary, Global Sea Mineral Resources, may be best positioned to take the lead if the Metals Company stumbles. "They've got the backing of a multibillion-dollar company and access to European resources for design," says Currie, the environmental lawyer. "They can wait 10 or 15

When the vehicle was just 50 feet from the surface, the UMBILICAL SNAPPED. The 35-ton machine went SPIRALING DOWN to the BOTTOM of the PACIFIC.

years and it wouldn't be the end of the world for them. Whereas with the Metals Company, look at their stock price. If their license isn't approved, it's hard to see how they survive." Global Sea Mineral Resources has also been running extensive tests in the Pacific—and learning its own lessons in how badly things can go wrong.

A FRANTIC KNOCKING on the metal door of his cabin jolted Kris De Bruyne awake. It was early in the morning of April 25, 2021, and De Bruyne, a Belgian engineer with Global Sea Mineral Resources, was aboard an industrial ship far out in the Pacific. De Bruyne was helming a team of researchers testing the Patania II, a bright green prototype nodule collector similar to the one deployed by the Metals Company. Now one of his team was shouting through the door: "Something really bad happened. The umbilical disconnected!"

It was, indeed, *really* bad. The umbilical is a Kevlar-jacketed cable stuffed with fiber-optic and copper wires. Nearly 3 miles long and as thick as a person's arm, it was the only thing tethering the Patania to the ship.

"Is it going down?" De Bruyne called back.

"Yes!"

De Bruyne scrambled into his red coveralls and ran up on deck. The crew had been hauling up the vehicle after a test drive. When it was just 50 feet from the surface, the umbilical snapped. The 35-ton vehicle went spiraling back down to the bottom of the Pacific. De Bruyne stared helplessly over the side.

Luckily, the Patania landed with its locator system intact, sending acoustic pings up to the ship. It took a couple of days, but crew members eventually maneuvered down a small submersible robot equipped with three-fingered Doctor Octopus tentacles to reattach the repaired umbilical. "It was relatively easy. Well, I say it was very easy, but it was also like 'AAAAHHH!' and 'NOOOO!'" De Bruyne recounted when I met him at Deme's headquarters near Antwerp, Belgium. "It was an emotional roller coaster."

When they hauled the Patania up, they found it almost completely undamaged. To De Bruyne, the snapped cable was just one of the "teething problems" that typically come with launching such a complex piece of equipment. Earlier in the expedition, he'd also had to contend with Greenpeace activists who had painted "RISK!" on his ship in huge yellow letters.

De Bruyne is fit, clean-shaven, and small in stature, with a fanboy's enthusiasm for his job. He's acutely conscious of the criticism directed at his industry, and he seems to take it personally. De Bruyne's parents were traveling veterinarians, and they raised him and his brother in Rwanda and Vietnam. "I grew up in nature. I'm not the nature destroyer they want me to be," he says. "The nongovernmental organizations and the environmentalists, they forget that we also have our stories and that we want to do something good for the world as well."

The Patania mission, he points out, was accompanied by a separate boatload of independent marine scientists who monitored the machine's impact on the ocean (as was the Metals Company's foray). Still, the more we talked, the more qualms he confesses. "Once in a while, I'll ask myself, am I still doing the right thing?" he says. "I still think we're doing the right thing, because we're still doing research." He says he's not even convinced deep-sea mining should go ahead. "We need to know what the impact would be of deep-sea mining, and I'm contributing to getting answers to that question. That's how I feel about it."

Global Sea Mineral Resources has already sunk at least $100 million into developing its subsea mining system, and it recently announced a partnership with Transocean, a major offshore oil-drilling outfit. The sea-mining company is now designing the much larger Patania III—the first of what the company hopes will be a fleet of full-scale mining robots that will hit the ocean floor around 2028.

The five years between now and then might be enough to develop the scientific understanding needed to craft regulations to safely mine the seafloor—or to determine whether it should be done at all. Or it might be time for alternatives, such as reducing private car ownership or recycling metals, to gain enough traction to make seabed mining superfluous. But frankly, none of these possibilities seem likely.

Gerard Barron is not planning to wait. "Got the boat, got the machine, announced the partnerships on how we're going to process the nodules," he says confidently. Assuming the Metals Company gets the go-ahead from the Seabed Authority, he says, everything is on track to start harvesting nodules by late 2024. The company's goal for its first year is 1.3 million tons, scaling up to 10 times that amount in the next decade.

The two-year deadline expires this summer. After Nauru put the Seabed Authority on notice, the agency hurriedly convened several meetings, but results have been scant. The pressure seems to be generating something of a backlash. At the authority's most recent meetings last November, several member states called for a "precautionary pause" on seabed mining, echoing the moratorium petition. According to Bloomberg, France's representative declared that his country did not consider itself obligated to approve mining until it was satisfied with the regulations, and several other countries indicated they felt similarly. The UK, India, and Japan, however, want to try to hit the 2023 deadline. Some activists are even calling for the Seabed Authority to be overhauled or replaced.

"The general feeling is, there's a lot of work to do and a lot of complex issues to be addressed. So when some country says, 'Just gimme a contract, I'm gonna get on with it,' it rankles enormously," says Currie, who attended the most recent round of Seabed Authority meetings. There's a widespread feeling that it is too soon to be giving out permission to start mining, he says, but it's not clear how the organization might stop that from happening. "No one," says Currie, "is sure how this will play out."

This story was supported by the Pulitzer Center on Crisis Reporting.

FROM TINY SEEDLINGS…

"Lionel and Patrick were very proud to unveil their new place, installed in an old hangar, a stone's throw from Paris," says Julien Faure, who photographs the founders of Neoplants, a startup which claims to have genetically engineered air-purifying houseplants. "Everything is optimized for the development of their plants, which are jealously protected—we could visit only after crossing several hermetic doors retaining the perfect temperature, light, and humidity conditions. Sadly, we had to 'sacrifice' a seedling for the shoot, because once extracted from its protective jar and in contact with the air (and the bacteria and fungus it contains), it was too fragile to survive afterwards."

Colophon

OLD BECOMES NEW

Wilson Hennessy is one of WIRED's go-to photographers for showcasing the latest gadgets—but this month's Gear came with a twist: "I loved the idea of 'forever products' that we just use and use—and shooting them to celebrate the fact they've got wear and tear, vs making them look shiny and new was a really fun challenge."

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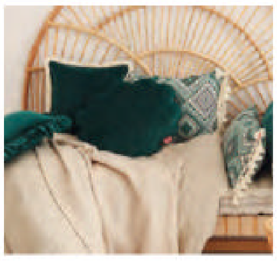

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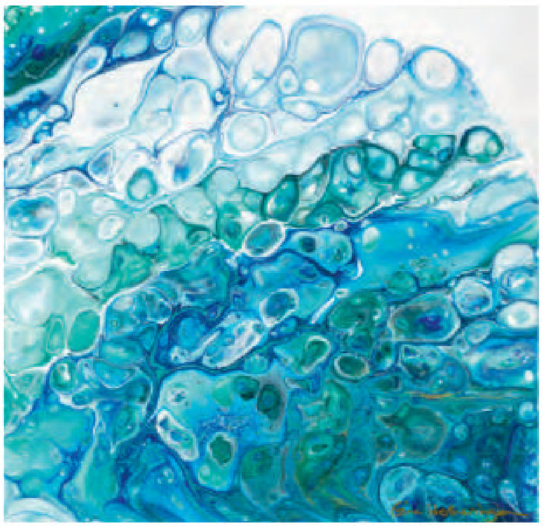

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Launched in 2020, Type B collection was founded on the principle of quality while offering exceptionally creative designs. Montreal-designed and Italian-made, Type B demonstrates the versatility of scarves. Designed to tell a story, each scarf is fabricated using hand-made materials and meticulous attention to detail. Visit **typebcollection.com** and follow **@typebcollection** on IG.

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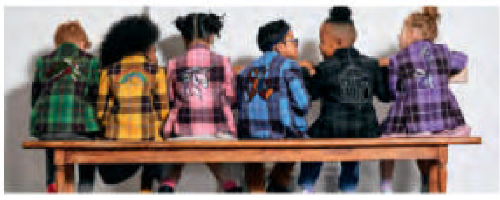

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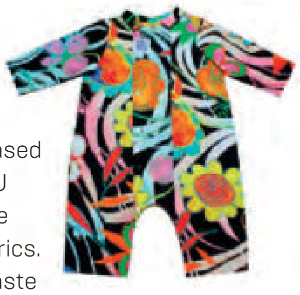

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The Los Angeles based brand YAY FOR YOU is sustainably made with deadstock fabrics. Babies with good taste everywhere will want more than one! 'The New Onesie' is designed to keep up with your baby's adventures. The unisex design provides maximum mobility and flexibility in any situation. Discover more at **yayforyoubaby.com** and follow **@yayforyoubaby** on IG.

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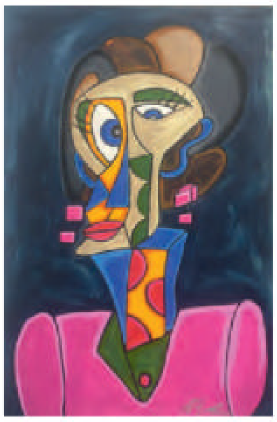

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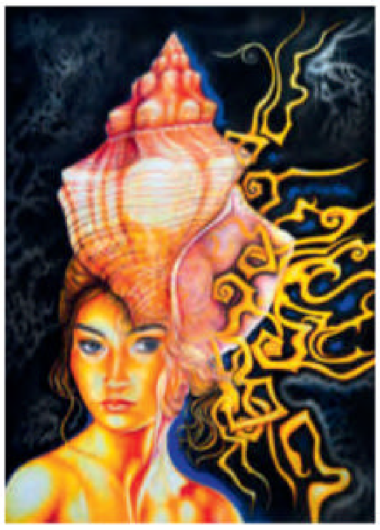

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Carmen Delprat's exotic art merges in several styles including fine art, surrealism and symbolism creating dreamy interpretations of the world around her. Carmen sells her unique art as originals, fine art prints, gift cards and stunning art scarves, paring art with luxury in perfect harmony and style. Visit **www.carmendelpratart.com** and follow **@carmendelpratart** on IG.

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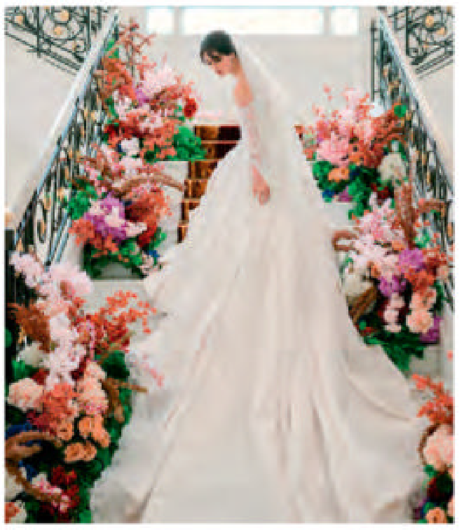
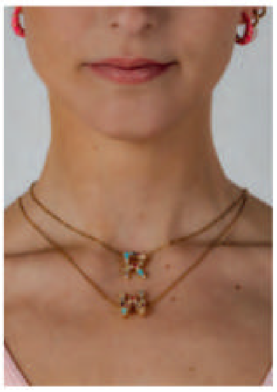
OTKUTYR

OTKUTYR's SS/23 Bridal Haute Couture capsule is inspired from a fairytale; depicting the feelings that a bride goes through on her monumental day. From the extremely detail oriented and regal, to the simple and body hugging silhouette for the girl next door. Special thanks to Jean Baraq lace for custom making OTKUTYR's lace design for the biggest wedding gown in the collection. 8 months of hand beading work following their visions, exact placement and design. OTKUTYR is proud to be the oldest French lace ambassador and to view the latest collection don't hesitate to book an appointment: **info@otkutyr.com.** Visit otkutyr.com and follow **@otkutyrfashionhouse** on IG.





ROYAL WAY

Royal Way was founded by the Young Portuguese entrepreneur Luisa Ferreira dos Santos in 2019, deciding to create and design her own brand with the beauty of elegant jewellery made of waterproof material (stainless steel) as well as portable personalised leather jewellery boxes. The brand also offers an elegant clothing line. Visit **royal-way.pt** and follow on IG: **@royalway_lfs**

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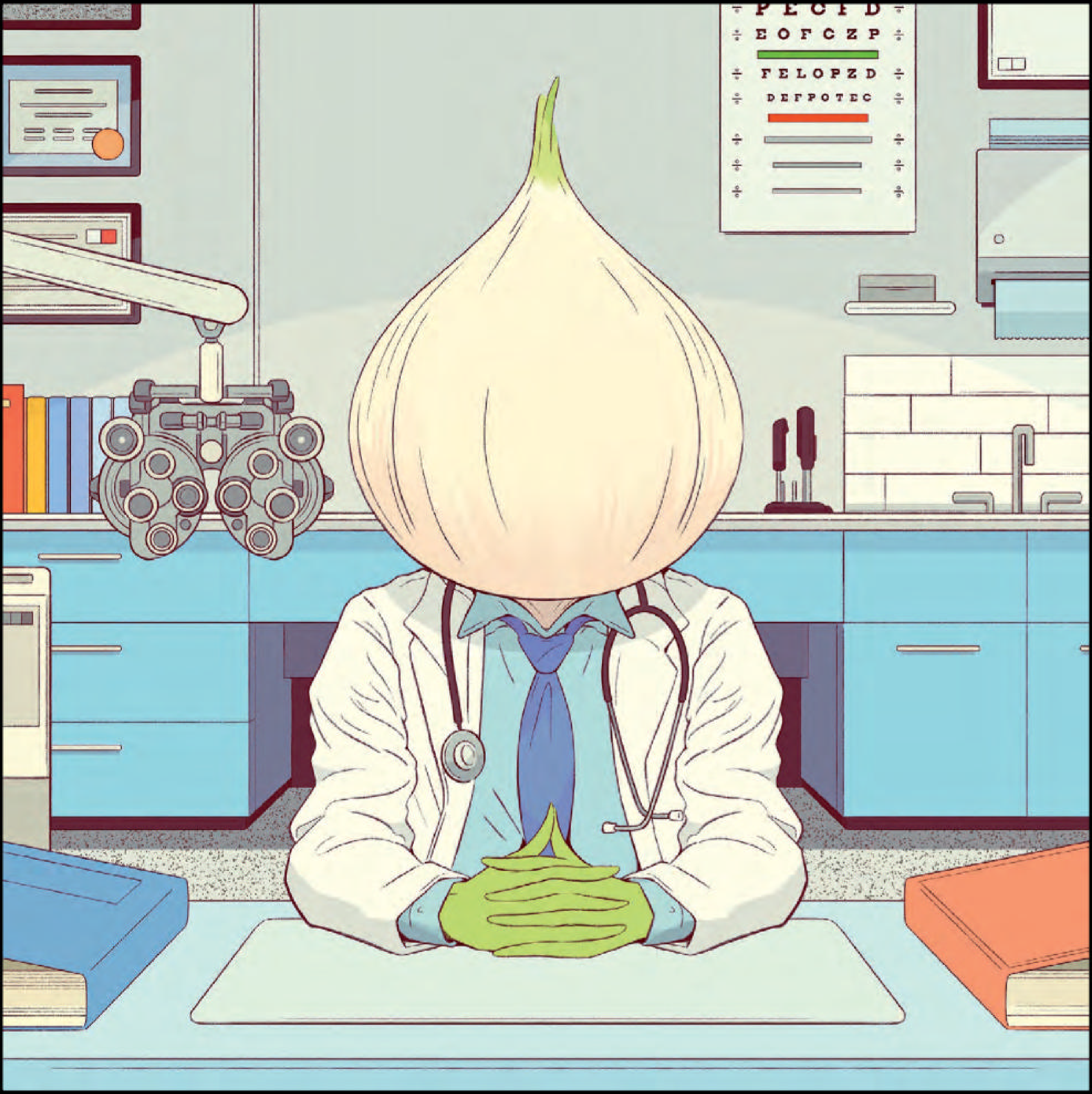
—@DaveDyball, via Twitter



Honorable Mentions

Mad I was, until it worked.
—Don Wilkins, via email

You say "mad," I say "disappointed."
—Joseph Ferry, via email

Her hair was blue—and undyed.
—@jaybirdfitlive, via Instagram

"Success!" Too bad the AI disagreed.
—Steve Nomax, via email

His socks matched her lab coat.
—@pmcruise, via Twitter

He couldn't make Earth look triangular.
—@pauloahb, via Instagram

"Let there be light," said God.
—@charley.desousa, via Instagram

"It's aliiiive!" Elon opened his eyes.
—@ylbertf, via Instagram

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SEA LION,
GALAPAGOS,
ECUADOR

ON OUR WATCH

Hope can now be spotted across all our planet's seas and oceans. Sites are made into aquatic havens by local communities, to safeguard the richness and diversity of the ecosystems they depend on. Sylvia Earle's invaluable experience as an explorer and marine biologist continues to help further their goal, through her organisation, Mission Blue. Together, they have created over 130 Hope Spots and counting. Carrying a message of hope for generations to come. It is that vision, that dedication to a perpetual planet, which we are proud to stand by. **For as long as it is needed.**

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